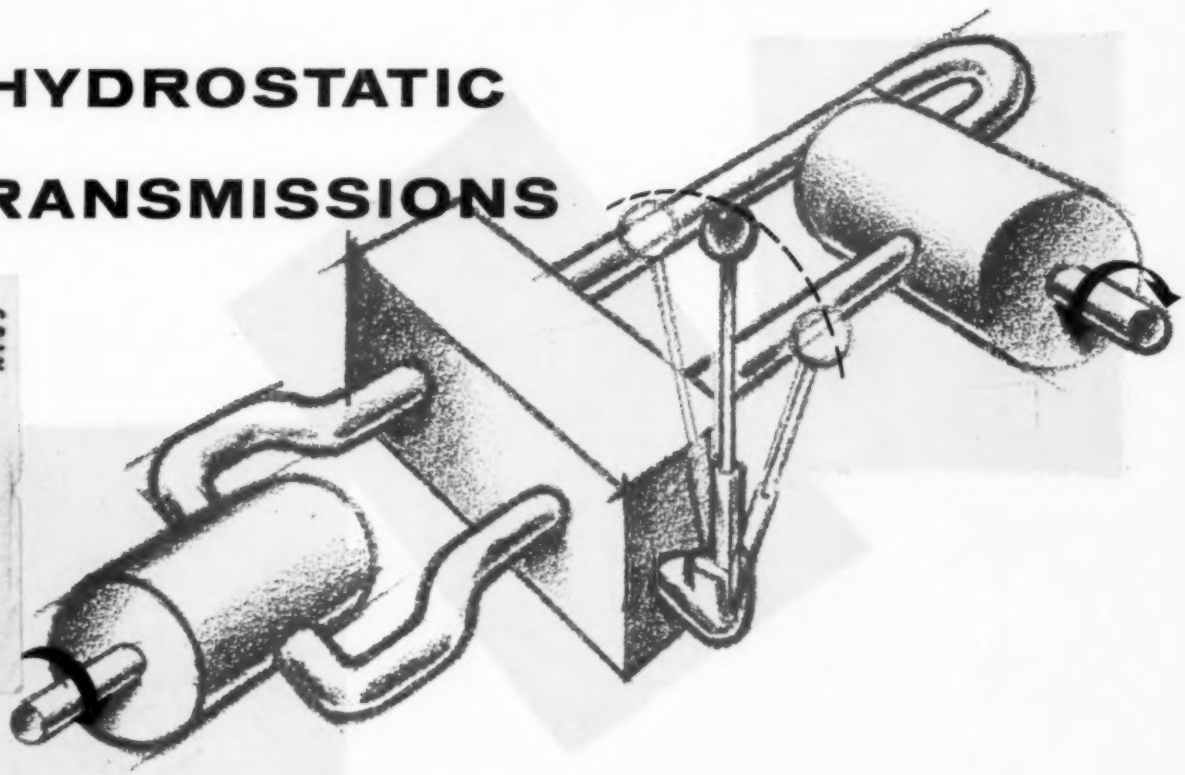
APPLIED HYDRAULICS

FRANCHISE CIRCULATION

DECEMBER 1956

THE MAGAZINE OF FLUID POWER | Air Circuits — Electrical Controls

HYDROSTATIC TRANSMISSIONS



STEVENS RICE
UNIVERSITY MICROFILMS
313 N FIRST ST
ANN ARBOR MICH A1J9

. . . for mobile equipment

For Information About
1957 PRIZE PAPER CONTEST
See page 24

TH

STEVENS INST.
UNIVERSITY MICROFILMS

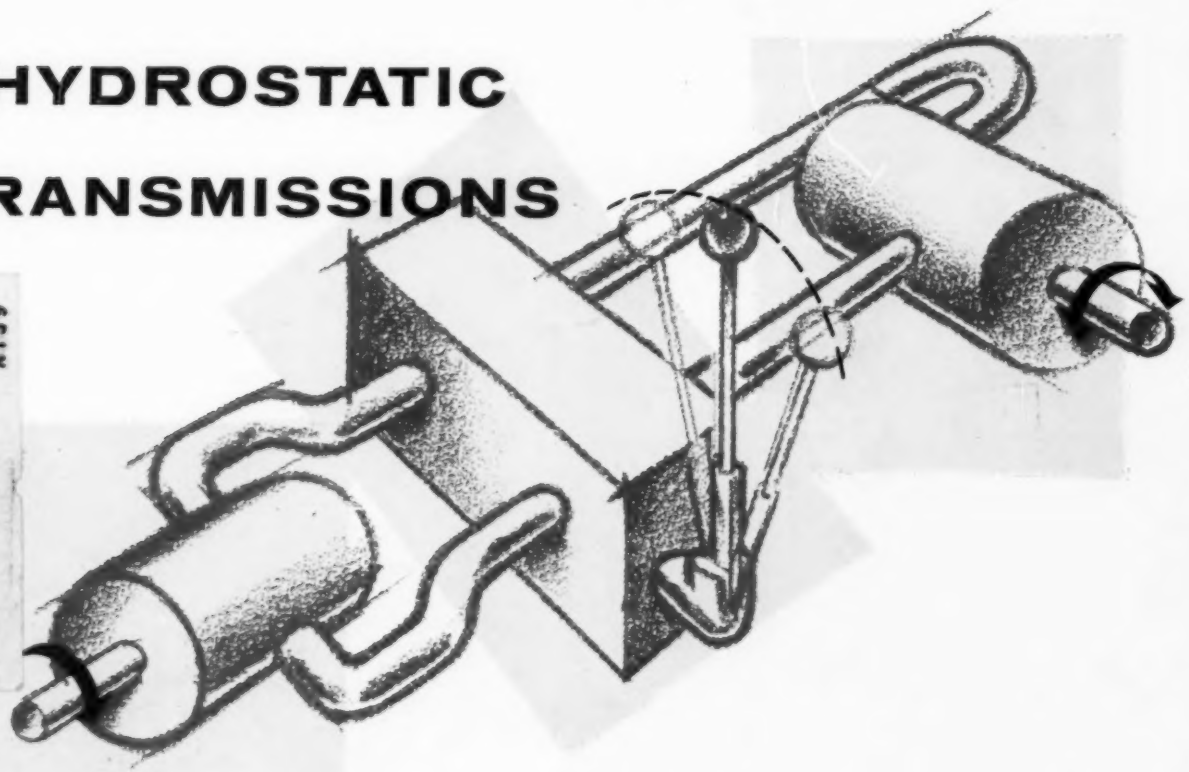
APPLIED HYDRAULICS

FRANCHISE CIRCULATION

DECEMBER 1956

THE MAGAZINE OF FLUID POWER | Air Circuits — Electrical Controls

HYDROSTATIC TRANSMISSIONS



STEVENS INST
UNIVERSITY MICROFILMS
313 N FIRST ST
ANN ARBOR MICH
A1J9

. . . for mobile equipment

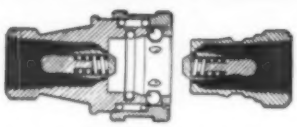
For Information About
1957 PRIZE PAPER CONTEST
See page 24

HANSEN

QUICK-CONNECTIVE 2-WAY SHUT-OFF COUPLINGS!

QUICK CONNECTION AND DISCONNECTION

INSTANT AUTOMATIC FLOW OR SHUT-OFF



Seals Both Ends of Line
AUTOMATICALLY INSTANTANEOUSLY

Quick Connective Fluid Line Couplings for

AIR • OIL • GREASE • HYDRAULIC FLUIDS • REFRIGERANTS • STEAM VACUUM • OXYGEN • ACETYLENE GASOLINE • COOLANTS • WATER

HOSE CLAMPS • HOSE CLAMP PLUGS • HOSE CLAMP SOCKETS HOSE CLAMP COUPLINGS

To connect a Hansen Two-Way Shut-Off Coupling, you just pull back the sleeve and push the Plug into the Socket. To disconnect, merely pull back sleeve. No tools required. Similar valves in Socket and Plug shut off both ends of line when Coupling is disconnected—practically eliminate spilling of liquid or escape of gas at instant of disconnection.

FEMALE PIPE THREAD CONNECTIONS FROM ⅛″ TO 1″

Hansen Series HK Two-Way Shut-Off Couplings are available with female pipe thread connections from ⅛″ to 1″ inclusive. Available in brass or steel.

Also Straight-Through and One-Way Shut-Off Couplings. Write for Catalog.

REPRESENTATIVES IN PRINCIPAL CITIES

SINCE 1915

QUICK-CONNECTIVE FLUID LINE COUPLINGS

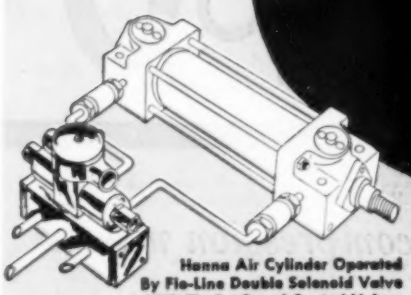
THE HANSEN MANUFACTURING COMPANY

4031 WEST 150th STREET • CLEVELAND 11, OHIO

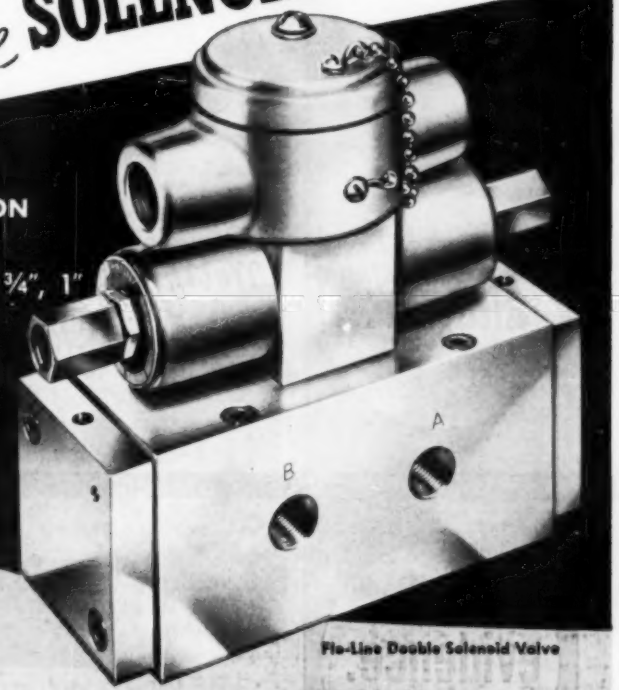
Circle 48 on Reader Service Card

HANNA *Flo-Line* SOLENOID VALVES

4-WAY VALVES
FOR AIR OPERATION
UP TO 150 PSI
SIZES: ¼", ⅜", ½" ¾", 1"



Hanna Air Cylinder Operated By Flo-Line Double Solenoid Valve With Flo-Set Speed Control Valves



Flo-Line Double Solenoid Valve

Hanna has designed and built new and unusual features in their Flo-Line Solenoid Valves . . . features that result in economy, more versatile operation and safety. Here are some of them:

- **Bubble Tight Spool** positively sealed by "O" rings.
- **Dust-Tight, Splash-Proof Design** to seal out dirt and moisture, and assure trouble free performance.
- **Few Moving Parts** for longer valve life.
- **Full Pipe Capacity** for all internal passages.
- **Wide Range of Temperatures and Pressures** —40° F. to 125° F.; 20 to 150 psi air. Options permit air pressure to 250 psi and even vacuum!
- **Enclosed Solenoid Coils** for safe operation.
- **AC or DC Service,** coils are available for most voltages and frequencies.
- **Meets JIC Recommendations** in all respects when ordered with optional manual over-ride.
- **Side or Manifold Porting** for easy installation and convenient piping.
- **Choice of Spools** permits selection of a standard valve for most applications.
- **Manual Over-ride,** an optional feature, allows equipment to be tested before final electrical installations are made and provides a means of operating the valve in case of electrical failure.
- **Junction Box** for ease in making electrical connections.
- **Modern Clean Cut Appearance**

You'll surely want the complete details given in the new Hanna Flo-Line Catalog No. 261A. See your classified telephone directory or Thomas' Register for the name of your nearest Hanna Representative—or write us direct.

Hanna Engineering Works

HYDRAULIC AND PNEUMATIC EQUIPMENT • CYLINDERS AND VALVES

1741 N. Elston Ave., Chicago 22, Illinois

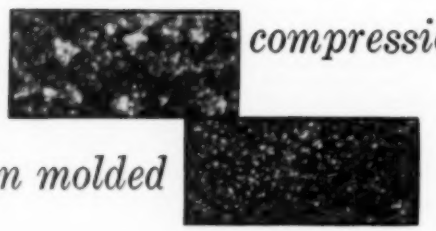
problem:

who makes longer-lasting rubber O-rings of ±.002" tolerance at low cost?

answer:

minnesota rubber and gasket company

evidence:



compression molded

injection molded

Minnesota Rubber O-rings are *injection molded* by the exclusive Minnesota Rubber process. Result is increased resistance to abrasions and chemical actions due to consistent, unequalled high density. Evidence of the greater density of injection molding is shown here in cross sections of Standard Buna N compound, .026"x.019", magnified 240 diameters by University of Minnesota.

In addition, Minnesota Rubber's O-rings have no flash. Tolerances can be kept within ±.002 inch. Cost? M.R. O-rings cost as little as ordinary O-rings! And M.R.'s 100% inspection and quality control saves you additional money in replacement costs, too.

free samples and data:

Free samples of Minnesota Rubber O-rings are available together with technical information and installation data.

minnesota rubber and gasket company

Originators of modern rubber injection molding
Dept. 104, 3630 Wooddale Ave., Minneapolis, Minn., Phone: WEst 9-6781

Circle 70 on Reader Service Card

APPLIED
HYDRAULICS
THE MAGAZINE OF FLUID POWER

DECEMBER 1956
VOLUME 9 NUMBER 12

Bennett H. Horchler
General Manager

Paul Rolnick
Editor

Allan E. Morris
Associate Editor

A. W. Benkendorf
Associate Editor

George H. Gutekunst, Jr.
Eastern Associate Editor

Nancy Rupp
Editorial Assistant

John A. Lankester
European Editor

Alaric Mausser
Art Director

Paul L. Reed
Consulting Editor

DEPARTMENTS

FLUID POWER LINES 6
LETTERS TO THE EDITOR 10
BRIEFS 18
FUTURE EVENTS 38
NEW PRODUCTS 42
USEFUL LITERATURE 48
FLUID POWER PIONEERS 52
POST SCRIPTS OF INDUSTRY 128
MARKET PLACE 140

BPA

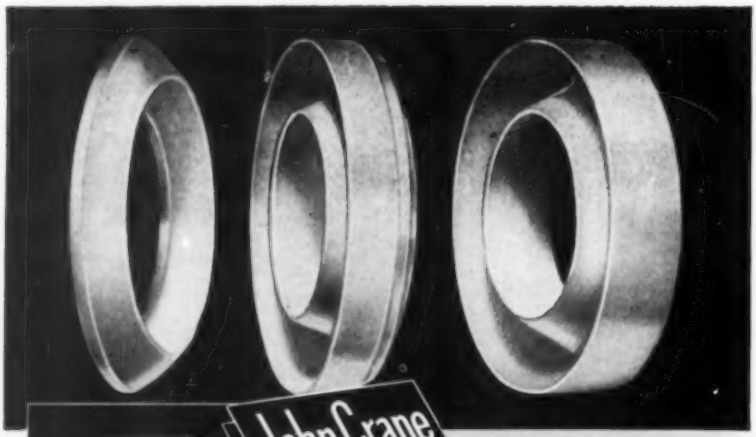
FEATURE ARTICLES

HYDROSTATIC TRANSMISSIONS . . . FOR MOBILE EQUIPMENT 57
HYDROSTATIC TRANSMISSIONS . . . FOR AGRICULTURE 59
By Sir George Dowty
FLUID MOTOR IN DRIVE WHEELS SIMPLIFY TRACTOR DESIGN 60
By H. J. Hamblin
HYDROSTATIC TRANSMISSIONS . . . FOR MINING 63
By Joseph J. Slomer
SERVO SPEED CONTROL FOR A HYDROSTATIC DRIVE 64
By E. M. Arentzen and D. J. Arnold
HYDROSTATIC TRANSMISSIONS . . . FOR CONSTRUCTION .. 67
By Sterling F. Winchell
DUAL FLUID MOTORS FOR TWO SPEED CONTROL 68
By William M. Shook
HYDROSTATIC TRANSMISSIONS . . . FOR RAILWAY MAINTENANCE 71
By E. J. Powell
RAILWAY MAINTENANCE 100% FLUID POWER 72
By E. J. Powell
HYDROSTATIC TRANSMISSIONS . . . FOR MATERIAL HANDLING 74
By C. E. Smith
DRIVE DEVELOPMENT FOR A FORK LIFT TRUCK 75
By Walter M. Shaffer
NEW BROOM SWEEPS CLEAN 82
MODELING WITH HYDRAULICS 86
By W. H. Chaffee and C. Markle
AIEE MACHINE TOOL CONFERENCE 102
1956 NCIH 107
1956 EDITORIAL INDEX 134

AVIATION SECTION

SYNTHESIS OF AIRCRAFT HYDRAULIC SERVOS 90
By George R. Keller and Elliott R. Buxton
INTEGRATED CONTROL SYSTEMS FOR AIRCRAFT 95
By R. Hadekel
HYDRAULIC AND PNEUMATIC PROBLEMS IN HIGH PERFORMANCE AIRCRAFT 98
By Ralph E. Middleton

THE INDUSTRIAL PUBLISHING CORPORATION
Copyright 1956



John Crane

CHEMLON *

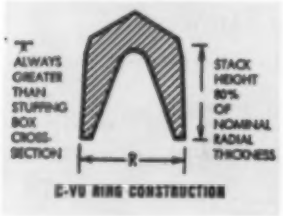
C-V RINGS

ARE INDUSTRY'S MOST UNIVERSAL PACKING . . .

Countless successful applications of C-V Rings under the most severe service conditions have made this the closest approach to a universal packing.

It will effectively handle all industrial acids, alkalis, solvents, organic and hydraulic fluids . . . temperatures from −120°F. to +500°F. . . . is equally suited to valves, pumps, mixers, hydraulic cylinders and like equipment.

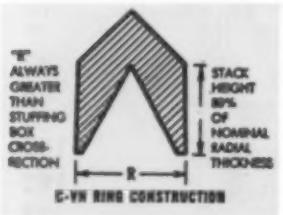
"John Crane" C-V Rings have extremely low coefficient of friction. "Breakout" friction is only slightly higher than running friction.



C-VU RING CONSTRUCTION

TWO STYLES ARE AVAILABLE:

C-VU RINGS *for low pressure service* —such as control and regulator valves handling gases and fluids, where it is necessary to have a very sensitive and resilient type packing.



C-VH RING CONSTRUCTION

C-VH RINGS *for high pressure service* —for use in pumps, hydraulic cylinders and like services at pressures ranging to 500 psi. and over. These rings are constructed with a heavy wall heel to withstand pressure requirements. They are designed to provide voids between rings, so that as the Teflon expands due to heat, this take-up room minimizes any excess friction in the stuffing box.

"John Crane" C-V Rings are available in full line of standard sizes and male and female adaptors. Sizes can be molded to stuffing box specifications.

Request Bulletin T-110.

*"John Crane" C-V Rings are made from Chemlon—*the best in DuPont Teflon.*

Crane Packing Co., 6405 Oakton St., Morton Grove, Ill. (Chicago Suburb). *In Canada: Crane Packing Co., Ltd., Hamilton, Ont.*

CRANE PACKING COMPANY

APPLIED

HYDRAULICS

Published monthly by
THE INDUSTRIAL PUBLISHING CORP.
812 Huron Road Cleveland 15, Ohio

IRVING B. HEXTER ..... President
LESTER P. AURBACH
..... Executive Vice-President
EDWIN M. JOSEPH ..... Vice-President

BUSINESS STAFF

BENNETT H. HORCHLER General Manager
WILLIAM L. JERSE ..... Production Manager
N. G. KISER ..... Circulation Director

SALES OFFICES

CLEVELAND 15 ..... SUperior 1-9622
R. D. SHATTUCK

NEW YORK 17 ..... MUrray Hill 7-3420
LEE HAAS, Manager
V. R. STEIN, Administrative Assistant
RONALD ROSE, Eastern Representative
60 E. 42nd St.—Room 803

CHICAGO 11 ..... WHitehall 3-1655-56-57
CHARLES F. GEYER, Manager
S. R. TRACY
520 N. Michigan Ave.—Room 1613

LOS ANGELES 57 ..... DUnkirk 9-9364
ALAN T. CAZIER, Manager
Room 8, Granada Building
672 South Lafayette Park Place

FT. LAUDERDALE, FLA. .....
HAROLD F. BEHM, Southern Manager
550 Pennsylvania
Melrose Park

LONDON S.W.1 ..... Victoria 2608
JOHN A. LANKESTER, Manager
31 Palace St., Westminster.

EUROPEAN REPRESENTATIVE .....
ERICH BOPP
22b Ingelheim (Rhein)
Western Germany

●

Also publishers of COMMERCIAL REFRIGERATION & AIR CONDITIONING, PRECISION METAL MOLDING, FLOW, INDUSTRY & WELDING, OCCUPATIONAL HAZARDS, MODERN OFFICE PROCEDURES, MATERIAL HANDLING ILLUSTRATED, and WELDING ILLUSTRATED. Member, Business Publications Audit of Circulation, Inc.

Subscription in United States and possessions—$5.00 per year; Canada—$6.00 per year; Foreign—$7.00 per year, except United Kingdom. United Kingdom subscription £ 2.5.0 per year, payable in Sterling to our London Office. Single copy price, 50 cents. All subscriptions subject to individual acceptance by the publisher.

Accepted as controlled circulation publication at Pontiac, Illinois. Please return 3579 forms to 812 Huron Road, Cleveland 15, Ohio.

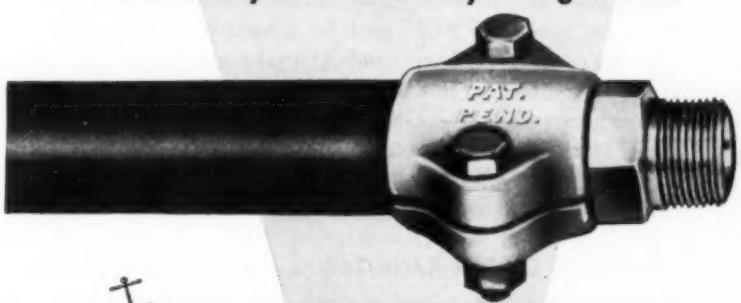
. . . . . and

ANCHOR

Clamp Type Couplings

(The Original)

. . . are ready for most any assignment!



In great demand for both O.E.M. and field emergency installation, this pioneer in the field of high pressure hydraulic clamp type couplings set a new standard—providing greatest simplicity, ease of installation and dependability.

The Anchor Clamp Type Coupling is ideally suited to the requirements of high pressure hydraulic (2-wire) applications. A lighter weight clamp type coupling is available for medium and low pressure use. A positive, leakproof connection is assured by the correctly designed barbs on the steel hose stem and the Anchor designed, gripping ridges on the malleable iron clamping halves. All parts are plated.

Anchor Clamp Type Couplings are also available in the Anchor Patented Flange Design, with a complete range of angle stems (0° to 90°) for installation in hard to reach locations.

Anchor Clamp Type Couplings may be removed and reinstalled many times without impairing efficiency. Available in a range of sizes ¼" to 2" I.D.

Play safe—always have a supply of these versatile Anchor Clamp Type Couplings on hand.

Ask for Catalog No. 301

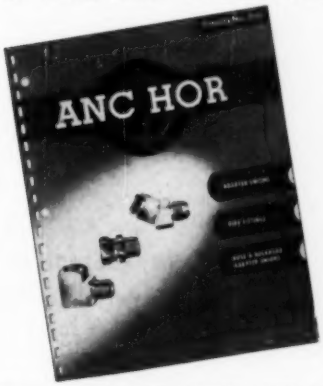
ANCHOR COUPLING CO. INC.

393 North Fourth Street • Libertyville, Illinois

Branch Offices: Dallas, Tex.; Plymouth, Mich.

Useful Literature

COMPLETE ENGINEERING DATA ON ANCHOR ADAPTER UNIONS, PIPE FITTINGS, AND SAE STRAIGHT THREAD "O" RING BOSS TYPE FITTINGS



The new Anchor Catalog No. 202, just off the press, contains the information needed by the hydraulic engineer to plan his hydraulic connections. Flow charts for adapter unions and fittings, formulas for calculating hose lengths and data on threads are given as well as specifications on the complete line of Anchor Adapter Unions, Pipe Fittings and the new, complete Anchor Line of SAE Straight Thread "O" Ring Boss Type Adapters and Fittings.

With these new SAE Boss Type Fittings, danger of thread distortion or damage to valve bodies is eliminated by the straight thread design. Use of the "O"-Ring Seal insures a positive leak-proof seating without excessive tightening, and permits loosening and retightening many times without leaks. Also shown in Catalog No. 202 is a new and complete line of Anchor Tube Nuts available in several styles and sizes.

The Anchor Line of Adapter Unions, Tees and Crosses is very complete as to size range and style of fitting. They are designed for use with pressed-on or reusable hose assemblies and provide a ground joint, leak-proof connection. By using them, one or more pipe thread joints are eliminated, and assembly in confined spaces is facilitated.

The new Catalog No. 202 may be had by writing to Anchor Coupling Co. Inc., 393 North Fourth Street, Libertyville, Illinois.

Fluid Power Lines

about Applied Hydraulics

COST AND RELIABILITY . . . Gathering material for this issue turned out to be more exciting than we had expected. Application of H-S transmissions in several areas described this month is still in the experimental stage. Because of obvious competitive reasons and because field tests might alter some of their present thinking, many engineers we talked with didn't want to crawl too far out on a limb. Nevertheless, there's a wealth of information in these articles. By studying what's being done in the five areas we selected, you'll get a good overall picture of H-S applications and development.

The big problems—cost and reliability—fall on the shoulders of the hydraulic component manufacturer. Designers of mobile equipment are ready and willing to increase the use of H-S transmissions if the transmission can be bought for a price which is in line with the cost of the whole machine. Because of this cost ratio, mining machine builders can afford variable volume units. Lift truck designers just wish they could.

A MIGHTY HUNGRY MACHINE . . . is the hydraulic miner presented on page 64. It chews through the coal seam at 2 tons per minute, responding faithfully to its driver's control. To keep it moving steadily, speed of the fluid motor driven crawlers is controlled by a hydraulic feedback pressure compensator.

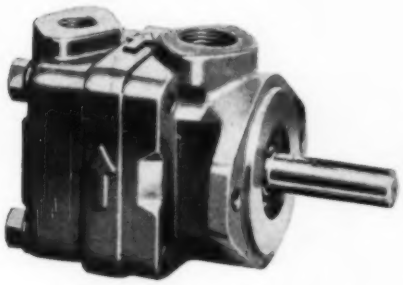
GAS TURBINES . . . driving a high speed pump at about 40,000 rpm to supply oil to drive motors is one of the visionary ideas H. J. Hamblin has suggested. His article in this issue describes an experimental rubber tired tractor driven at speeds up to 15 mph by a hydrostatic transmission. Of course, a conventional internal combustion engine is the prime mover. But what does the future hold? Hamblin suggests that the greatest impact of a hydrostatic drive could be that it permits use of a simple gas turbine drive. With the gas turbine and a hydrostatic transmission more power could be packed into available space.

"WORKING ON THE RAILROAD" . . . used to be sung by a chorus. Now it's a trio or even duet, because railway maintenance is being done by machines. Hydraulically operated equipment for cleaning rock ballast and installing ties is illustrated on page 72. Mounted on a standard tractor, the equipment has slow working speeds which require a hydrostatic drive to prevent burning out transmission clutches.

SOME OF THE INSPIRATION . . . for the Gradall earthmover, described by Chief Engineer Bill Shook, must have come from a childhood love of digging in the dirt. Adaptable to numerous operations, the track-mounted unit detailed on page 68 has all motions powered hydraulically, including a hydrostatic crawler drive.

THE MODEL WE'VE DESCRIBED . . . on page 86 may not be as cute as others you've studied, but you'll have to agree it's very neatly put together. The model was built for exhibition at industrial shows. Remember the article in October 1955 which described the oil powered sofabed! It used miniature, highly reliable hydraulics similar to the equipment on the model truck.

Precision "O" Rings protect the Heart of Hydraulic Power Steering Systems.



Precision "O" Rings provide positive hydraulic oil seal in this 1500 P.S.I. Mobile pump in a temperature range up to 160°F. Quality control in "O" Ring manufacture protects this heart of a power steering system.

Precision "O" Rings

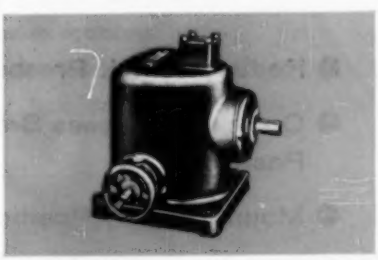
There can be no compromise on quality and reliability in hydraulic power steering pumps. VICKERS Incorporated, of Detroit, Mich., the world's largest manufacturer of fine hydraulic pumps, use Precision "O" Rings to assure dependable, long life performance under exacting conditions.

Precision "O" Rings are used in the majority of VICKERS mobile and industrial hydraulic pumps. For VICKERS Incorporated and hundreds of other manufacturers, the use of Precision "O" Rings means economical, efficient, leak-proof operation.

Precision compression molded "O" Rings are rigidly inspected – quality-controlled – meet all military and commercial specifications – the finest made! Precision can furnish the size and compound that fits your product requirements.

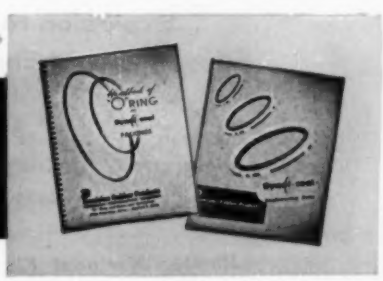
Place your sealing problem in the hands of an expert – the Precision engineer. He can assist you in product design. Rely on Precision, the world's largest exclusive producer of "O" Rings.

In VICKERS constant delivery vane type pumps, used on Industrial machinery, Precision "O" Rings are used in pump, unloading and pressure relief valve sections to provide effective seals against hydraulic oil leakage.



In VICKERS variable delivery piston type pumps, used on Industrial machinery, Precision "O" Rings give exacting service in sealing against hydraulic oil pressure up to 3000 P.S.I.

Write for your free copies of Precision catalogs on "O" Rings and Dyna-seals

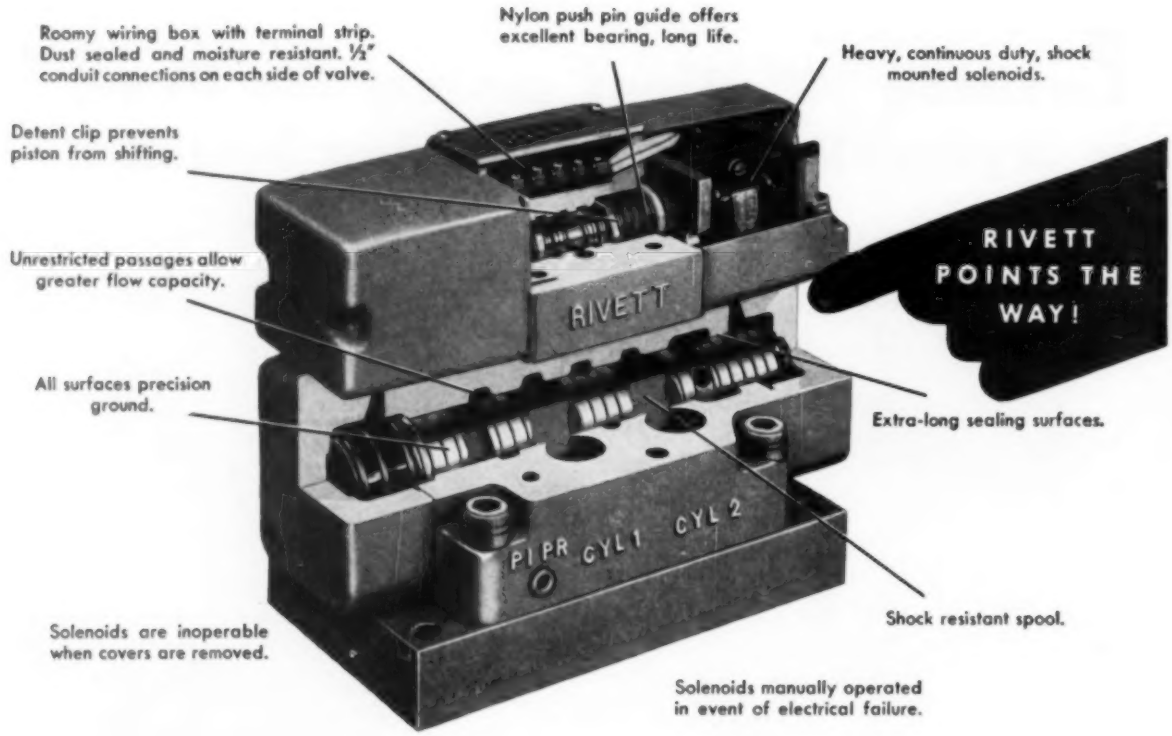


Precision Rubber Products Corporation • "O" Ring and Dyna-seal Specialists

Dept. 1, Oakridge Drive, Dayton 7, Ohio

Canadian Plant at: Ste. Thérèse de Blainville, Québec

Circle 84 on Reader Service Card


Roomy wiring box with terminal strip. Dust sealed and moisture resistant. ½" conduit connections on each side of valve.
Nylon push pin guide offers excellent bearing, long life.
Heavy, continuous duty, shock mounted solenoids.
Detent clip prevents piston from shifting.
RIVETT POINTS THE WAY!
Unrestricted passages allow greater flow capacity.
All surfaces precision ground.
Extra-long sealing surfaces.
RIVETT
P I PR CYL 1 CYL 2
Shock resistant spool.
Solenoids are inoperable when covers are removed.
Solenoids manually operated in event of electrical failure.

High Flow Capacity!

Rivett's New Solenoid Pilot Operated Hydraulic 1" Valve Is Rated at 28 G.P.M. and the 1½" Size At 82.5 G.P.M., At 15 Ft. Per Sec. Velocity.

- Reduces Back Pressure, Friction, Heat
- Opens and Closes Smoothly, Positively
- Mounts In Any Position
- 3000 P.S.I. Operation for Multi-Million Cycles
- Optional: Built-in Speed Controls
  Explosion Resistant
  Solenoid Enclosures

Forget about back pressure by specifying Rivett 6600's for service up to 3000 P.S.I. Reduce inventory! Select off the shelf: 2 basic sizes fit ⅜", ½", ¾", 1", 1¼" and 1½" I.P.S. Single and double solenoid. 7 spool designs. Meet *all* J.I.C. requirements.

RIVETT, INCORPORATED • Dept. AH-12
Brighton 35, Boston, Mass.

THE BETTER YOU KNOW HYDRAULICS THE BETTER YOU LIKE

Get Catalog No. 261 to aid your circuit design. Complete drawings, specifications, cut-away views, tables, diagrams!

RIVETT "100" HYDRAULIC VALVES

Member National Fluid Power Association

NOW

EFFICIENT FIRE PROTECTION FOR HYDRAULIC SYSTEMS WITH THESE TWO HOUGHTON FLUIDS:

HOUGHTO-SAFE 620

For all normal hydraulic temperatures and bearing loads (up to 85% of all needs)

HOUGHTO-SAFE 620 is a time-proven water-base hydraulic fluid that provides maximum protection against hydraulic fires. Its efficiency is proven by more than 4 years use in industry and over 2 years in Navy carrier catapults.

HOUGHTO-SAFE 620 has no effect on standard packings used in oil or water hydraulic systems—is not toxic—and provides greater efficiency at lowest installed cost for most hydraulic systems.

THE NEW

HOUGHTO-SAFE 1020

For systems running consistently over 150°F. and for heavily loaded pumps and bearings

HOUGHTO-SAFE 1020 is a new *fortified* synthetic hydraulic fluid expressly compounded to provide greater efficiency in systems where temperatures repeatedly exceed 150°F.

HOUGHTO-SAFE 1020 provides complete rust protection; resists foaming; is stable in use and storage, low in toxicity, and high in oiliness. It's *different* from former non-aqueous fluids.

Find out today how you can now eliminate the fire hazard in any hydraulic system with the Houghton fire-resistant fluid that will provide greatest operating efficiency. Ask your Houghton Man or write to E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.

HOUGHTO-SAFE

. . . products of

E. F. HOUGHTON & CO.

PHILADELPHIA · CHICAGO · DETROIT · SAN FRANCISCO

Ready to give you on-the-job service . . .

SAVE MONEY WHILE SPENDING IT!

Specify

HYDRO-LINE

AIR & HYDRAULIC CYLINDERS

SAVE SPACE...

SPEED PRODUCTION...

SAVE DOWNTIME...

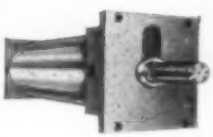
Compact design of HYDRO-LINE Cylinders with *exclusive* quick-change rod cartridge permits immediate replacement of rod seal, double lip rod wiper and rod bushing without removing or dismantling the main cylinder assembly. Other of HYDRO-LINE'S exclusive combination of features includes: all-steel end caps, one-piece piston retained by prevailing torque-type lock-nut, hard chrome plated piston rods, wrench-flats, heavy cushion adjusting needle valve interchangeable with ball check valve. Meet all JIC Standards.

WHEN YOU DESIGN . . . REMEMBER HYDRO-LINE!

SERIES R—Air or Low Pressure Hydraulic Heavy Duty Cylinder

TYPICAL APPLICATIONS

Clamping Fixtures
Loading & Unloading Devices
Counter Balance
Welding Machines
Air Clutches



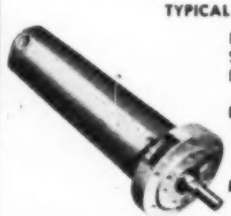
•

Bulletin Available at Later Date

SERIES J—High Pressure Hydraulic Extra Heavy Duty Cylinder

TYPICAL APPLICATIONS

Feed Cylinders
Slide Cylinders
Die Casting Shot Cylinders
Drilling & Tapping Machines



•

Request Bulletin 53

SERIES S—Air or Low Pressure Hydraulic Extra Heavy Duty Automation Cylinder

TYPICAL APPLICATIONS

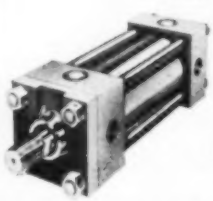
Clamping Fixtures
Welding Machines
Automation Equipment
Loading & Unloading Devices

Request Bulletin 55

SERIES N—High Pressure Hydraulic Heavy Duty Cylinder

TYPICAL APPLICATIONS

Feed Cylinders
Welding Machines
Die Casting Machines
General Machine Tools



•

Request Bulletin 56

• Hydraulic and Air Cylinders • Dispensing Cylinders • Single Acting Cylinders • Adjustable Stroke Cylinders • Intensifiers

Representatives in all Principal Cities. Write for the name of the Hydro-Line Rep in your locality.

YOUR SAVINGS BEGIN HERE!

Please send bulletin ☐ 53 ☐ 55 ☐ 56

NAME_____

FIRM_____

ADDRESS_____

CITY_____ STATE_____

Hydro-Line CYLINDERS

Remember HYDRO-LINE when you design

HYDRO-LINE MANUFACTURING CO.

5605 PIKE ROAD • ROCKFORD, ILLINOIS

LETTERS to the editor

Address your letters to: Editor, APPLIED HYDRAULICS Magazine, 812 Huron Rd., Cleveland 15, Ohio.

High Speed Small Cylinders

We want a double-acting, hydraulic cylinder which is 1" bore, or less; a 4-way, two position directional control valve which will be cam operated for use in an industrial hydraulic system where the line pressure will be 1000 psi or less. Flows will be of the order of 2 gpm.

Our requirement, however, is complicated by the need for units that will cycle (2 strokes) at the rate of 180 times per minute continuously. Do you know of any firms that produce units that will meet this continuous cycling rate with a minimum of maintenance and part replacement? Or what is the maximum cycling rate obtainable coupled with a reasonable maintenance schedule?

SOL DUDNICK
Mechanical Design Engineer
Universal Machine Co. Inc.
Baltimore 30, Md.

You didn't give us the length of stroke, which is important. We've sent you the name of suppliers of small bore cylinders. A number of factors which you haven't given in your letter will have to be studied to determine reliable operation.

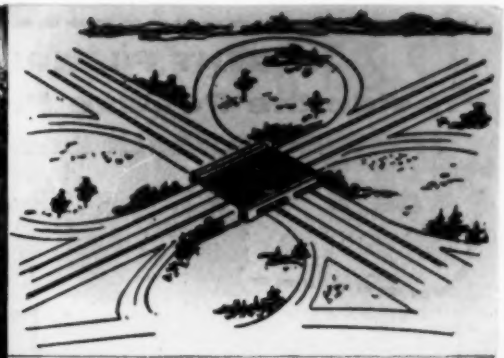
How to Get Standards

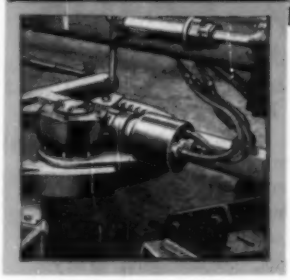
I'd like to know where to purchase bulletins covering hydraulic specifications and standard sizes of the following organizations: MIL, AMS, SAE, ASTM, AN, MS, JIC, AND NAS.

GEORGE VEGELLA
Engineering
[illegible]
Hazel Park, Mich.

MIL, AN, AND MS are government specs. If you contact your nearest U.S. Air Force Procurement Office they'll help you obtain these specs. We don't know of any AMS, ASTM or NAS specs pertaining to hydraulics. For a copy

Continued on page 12





GALION 104 Motor Grader, above, uses Eastman Assemblies on *EIGHT* Hydraulic controls for more accurate, effortless and economical grading. Close-up, left, shows powerful Hydraulic Circle Turn for famous Galion "Reversible" Moldboard.

BARBER-GREENE Bituminous Finisher, right, automatically lays level finish for smoother, safer travel. Close-up shows Eastman Hydraulic Hose Assembly delivering 2,700 lbs. pressure to raise and lower finishing screed.

Smoother, Safer Roads

BUILT WITH HYDRAULIC POWER

DELIVERED THROUGH

Eastman

HYDRAULIC HOSE ASSEMBLIES

ALWAYS SPECIFY

EASTMAN Pressed-on, Reusable and Renewable Couplings for high and low pressure air, gas, water, paint, grease and hydraulic fluids. Eastman Straight and Angled Adapter Unions.

Smoother, safer highways are being built today through the application of modern engineering and the use of modern equipment—much of which is hydraulically operated—using Eastman Hydraulic Hose Assemblies.

GALION—pioneer builder of road machinery—whose Motor Graders and Rollers are used 'round the world—first used hydraulic controls as early as 1927. Eastman Mfg. Co. pioneered in the development of Hydraulic Hose Assemblies in 1926—and *Galion is Eastman equipped today!*

BARBER-GREENE—whose Bituminous Road Finishers have been used at one time or another on almost every road ever built—also uses Eastman Hydraulic Hose Assemblies. Hydraulic power is used to raise and lower the all-important mechanism which lays a level finish—regardless of irregularities in the base. Barber-Greene's founding date of 1916 closely parallels Eastman's of 1914—and *Barber-Greene is Eastman equipped today!*

EASTMAN—*first in the field*—is proud to have pioneers such as Galion and Barber-Greene—as well as many other leading American manufacturers—use Eastman Hydraulic Hose Assemblies. Look to Eastman for *continued leadership* in engineering and design for quality of material and workmanship—plus better-than-ever service through expanded production facilities of our new, modern plant.

SAFEGUARDING INDUSTRY'S *Lifetime of Mobile Power*

Eastman

first in the field

MANUFACTURING COMPANY

Dept. AH-12, Manitowoc, Wis.

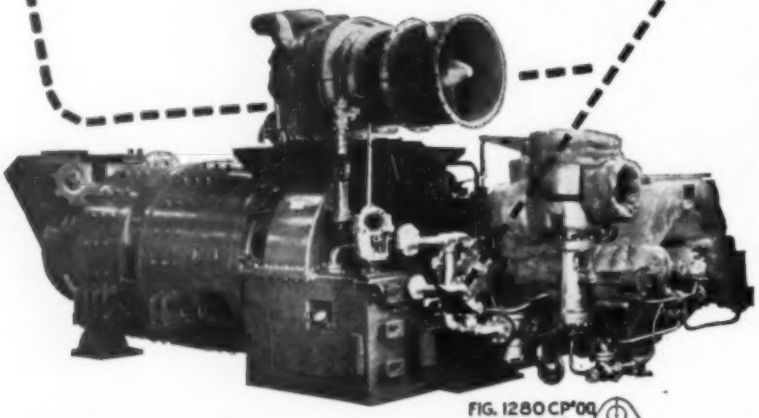
Circle 34 on Reader Service Card

BUILD BETTER ROADS TODAY · FOR A GREATER AMERICA

See you at the ROAD SHOW CHICAGO Jan. 28-Feb. 2, 1957

BOOTH NO. 339—SECTION A
(North Hall, 2nd floor)

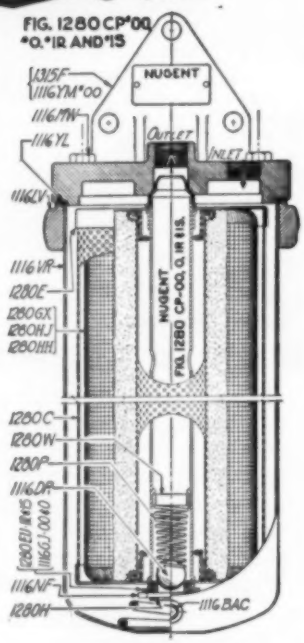
NUGENT FILTERS
Provide the Positive Protection
Fine Equipment Deserves



The turbogenerator shown above, power plant for the new Norfolk & Western 4500 H.P. experimental locomotive, is assured of maximum protection against mechanical breakdowns due to improper lube oil filtering. Installed on the unit is a Nugent 1280 CP size 1R Absorbent Oil Filter which effectively filters the main gear and pinion lube oil for the generator drive.

Operators of diesel engines, gas engines, turbines and other vital machinery know there is no substitute for safe, low cost, reliable filtering. For this very reason, *Nugent Filters are selected first*—to keep oiling and filtering systems in tip-top shape the year 'round.

Do yourself and your machinery a favor. Check some Nugent equipped installations. Ask the men who know first hand about the value of Nugent filters. Find out how Nugent filters protect your equipment and insure long life . . . how they offer *greater filtering area . . . increase engine dependability* and *do it at lower overall cost!*



For full technical details and specifications, write today outlining your filtering requirements.

Upper right: Sectional view of factory packaged "Throway" Nugent filter recharge.

Lower right: Nugent Fig. 1280CP Pressure Fuel Filter.

Wm. W. Nugent & Co., Inc.
3432 Cleveland St. Skokie, Illinois

Established 1897

OIL FILTERS, OILING AND FILTERING SYSTEMS, TELESCOPIC OILERS, OILING DEVICES, SIGHT FEED VALVES, FLOW INDICATORS
Representatives in Boston • Cincinnati • Detroit • Houston • La Junta, Colo. • Los Angeles • Minneapolis • New Orleans • New York • Philadelphia • Portland, Ore. • San Francisco • Seattle • St. Louis • Tulsa • Representatives in Canada: Montreal • Toronto • Vancouver

LETTERS to the editor

of the JIC Standards write JIC, Box 182 Northend Station, Detroit 2, Michigan. SAE specs are published in this organization's yearly handbook which can be purchased from SAE headquarters 485 Lexington Ave., New York 17, N.Y.

Small Volume Metering

In answer to a question by R. I. Shuman, Elevator Engrg. Co., Baltimore, (A.H. October 1956) as to where information on metering pump could be obtained, I suggest that he contact the Swiss Industrial Company, Nauhausen Rhine Falls, Switzerland. They manufacture a metering pump, similar to the one described in APPLIED HYDRAULICS, July, 1956.

R. BURGAT
Designer
Montreal, Canada

Wants Hydraulic Clutch

Who manufactures a hydraulic clutch similar to the air actuated unit produced by the Fawick Corporation. This clutch would be hydraulically actuated by a bellows which would engage the clutch plates to furnish the engagement to transmit power.

HARRY R. HOLSEN
Industrial Hydraulic Co.
Milwaukee, Wis.

Perhaps AH readers will send in a suggestion for Mr. Holsen.

Big Valves

Could you suggest the names of manufacturers who have hydraulic valves for 3,000 psi service in sizes of 2" and up to 4". We are looking for valves such as directional valves, sequence valves, relief valves to handle flows in the order of 500 gpm.

J. B. WILEY, JR.
Hummel Technical Products, Inc.
New York, N. Y.

We've sent a few suggestions to Mr. Wiley. Can a reader offer some help.

Continued on page 14

Circle 75 on Reader Service Card

Circle 69

Miller

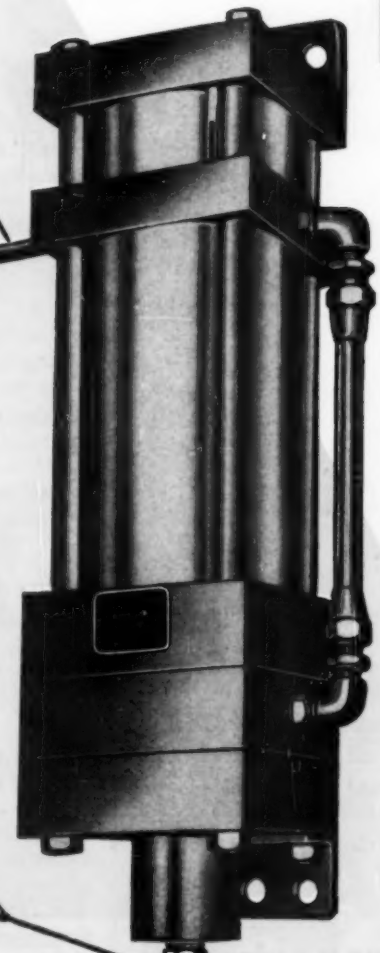
FLUID PRESSURE BOOSTERS

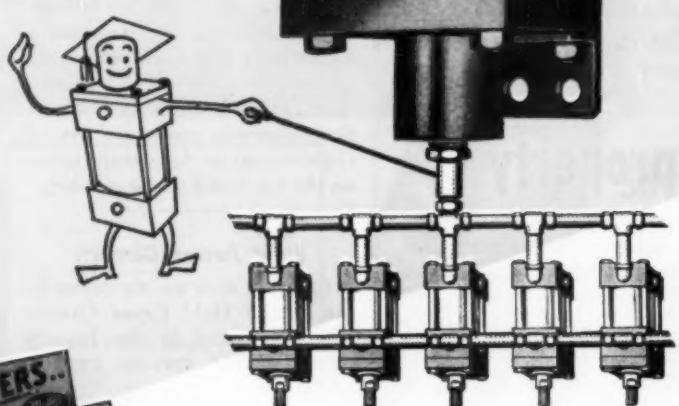
BOOST 80 PSI AIR

Input Range: 40 to 3000 psi Air or Fluid

TO 2000 PSI HYDRAULIC PRESSURE

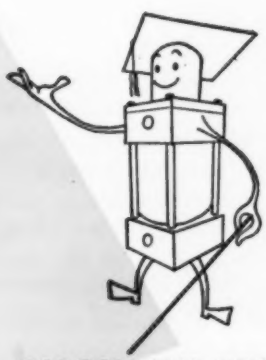
Output Range: 200 to 10,000 psi Fluid





- Save space, weight and investment cost by replacing pump installations in many applications.
- Less costly to install, operate and maintain.
- **Hold Pressure indefinitely** without the motion and heat generation of ordinary pump circuits.
- Provide—at point of cylinder thrust—more efficient power with less weight in less space than direct driven air cylinders
- Save up to 95% of air consumed by direct driven air cylinders
- Operate at speeds of 30 to 450 strokes per minute.

NOTE: In addition to its most complete line of "Custom-Built" Boosters available on normal delivery Miller offers 5" bore, 25 to 1 ratio, boosters for immediate delivery in either 6" or 12" stroke. Write for data and prices.



ESPECIALLY RECOMMENDED FOR

- **WELDING**
- **PUNCHING**
- **SHEARING**
- **CLAMPING**
- **RIVETING**
- **CRIMPING**
- **PRESSING**

and similar applications

FULL DETAILS IN MILLER BULLETIN B-200 SENT FREE ON REQUEST

Other Miller products include: Air cylinders, 1½" to 20" Bores, 200 PSI operation; low pressure hydraulic cylinders, 1½" to 6" bores for 500 PSI operation, 8" to 14" bores for 250 PSI; high pressure hydraulic cylinders, 1½" to 12" bores, 2000-3000 PSI operation. All mounting styles available.

SALES AND SERVICE FROM COAST TO COAST

CLEVELAND • YOUNGSTOWN • DAYTON • PITTSBURGH • PHILADELPHIA • BOSTON • HARTFORD • NEW YORK CITY • BUFFALO • ST. PAUL • GRAND RAPIDS • DETROIT • FLINT • FORT WAYNE • SOUTH BEND • INDIANAPOLIS • MILWAUKEE • LOUISVILLE • KANSAS CITY • SEATTLE • LOS ANGELES • SAN FRANCISCO • BALTIMORE • DENVER • ST. LOUIS • MOLINE • CHICAGO • HOUSTON • TORONTO, CANADA and OTHER AREAS

Miller

MILLER FLUID POWER DIVISION FLICK-REEDY CORP.

2008 N. Hawthorne Ave., Melrose Park, Ill.

AIR & HYDRAULIC CYLINDERS • BOOSTERS • ACCUMULATORS
COUNTERBALANCE CYLINDERS

There's safety in these NEW numbers

UCON BRAND Hydrolube 150-CP

(Viscosity—approx. 150 S.U.S. at 100° F.)

UCON BRAND Hydrolube 275-CP

(Viscosity—approx. 275 S.U.S. at 100° F.)

Yes, there's safety in these two new grades of UCON *Hydrolubes —*CARBIDE*'s safety hydraulic fluids.*

Greater safety for machines

These new UCON "CP" Hydrolubes...

- Contain improved liquid and vapor phase corrosion inhibitors for the common metals.
- Have good lubricity. Special anti-wear agents provide improved pump life and performance characteristics.
- Have high viscosity indexes—150 to 160.
- Have low pour points—can be used at sub-zero temperatures.
- Have no harmful effects on packings and seals. Leakage losses are often lower than with other hydraulic fluids.
- And, are made in the two standard viscosity grades—others can be supplied to fit specific requirements.

Safety for men and property

- The resistance of UCON Hydrolubes to burning has been proved by years of exhaustive testing in the laboratory and, by more than 8 years of practical application under standard industrial conditions. UCON Hydrolubes are water-base hydraulic fluids—the water content is the key to their fire-resistance.
- And, for all practical hydraulic purposes, UCON Hydrolubes are non-toxic to workmen.

For safety's sake, get all the facts. Write *today* for the new booklet, "UCON Hydrolubes Spell Safety," Form 40134.

CARBIDE AND CARBON CHEMICALS

CARBIDE AND CARBON CHEMICALS COMPANY
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, N. Y.

"Ucon" is a registered trade-mark of Union Carbide.

LETTERS to the editor

Servos

Do you have available a list of published articles pertaining to hydraulic servomechanisms? We are interested in medium and low power (1-10 horsepower) components which have previously been used in servo systems and may be commercially available.

CARL R. LUNDBERG
Designer
Erco Division
ACF Industries
Riverdale, Maryland

We've sent Mr. Lundberg a copy of the January 1956 *issue which included a Fluid Power Engineering Index for the years* 1931-1955. *In this issue, the* 1956 *Editorial Index lists articles published this year on servos.*

Drive for Paper Machine

Can you tell us who supplies a hydraulic drive for a paper machine.

W. R. MATTHEWS
Spokane, Wash.

We've sent a list from the MASTER CATALOG OF FLUID POWER *giving manufacturers of hydraulic transmissions. There are many drives for paper machinery being powered by hydrostatic transmission. If you will supply information concerning power and control requirements to the manufacturers on the list, you'll find a supplier.*

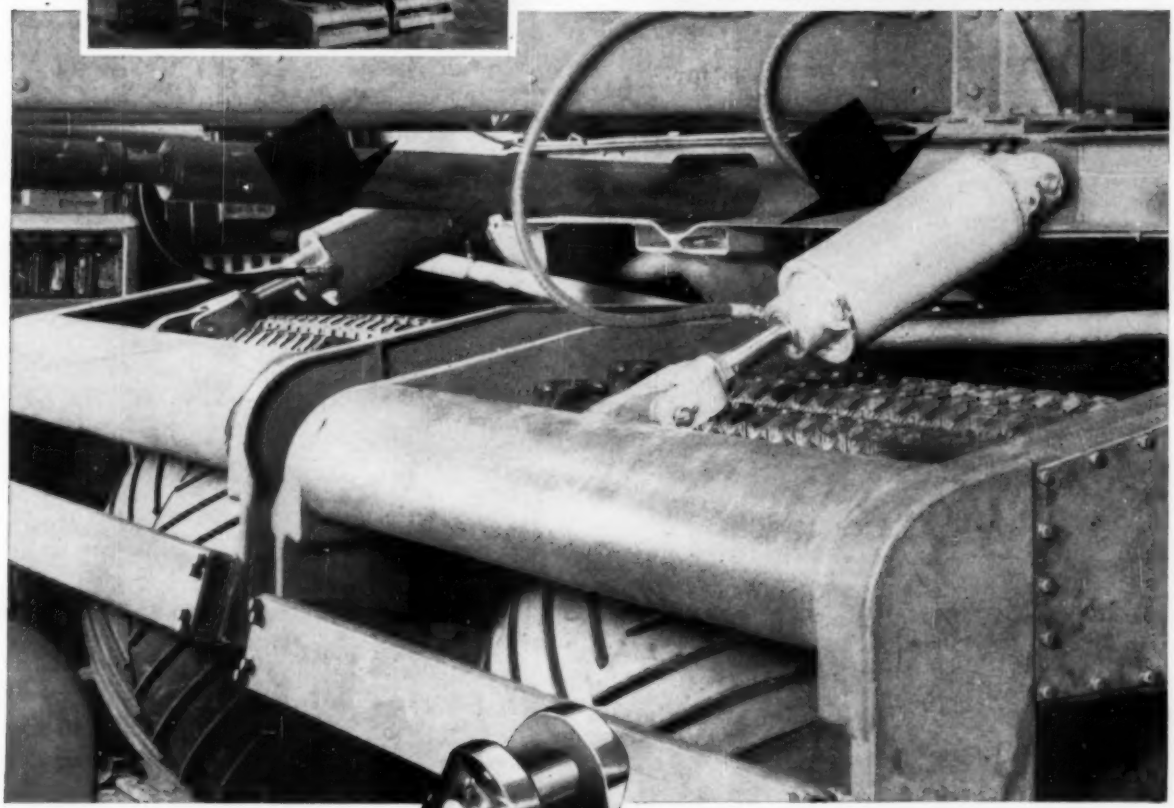
Fluid Power Circuits

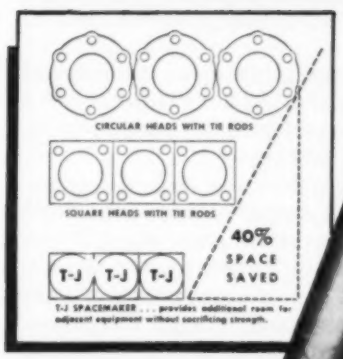
Can you send me six copies of the booklet Fluid Power Circuits which appeared in the January 1954 issue of APPLIED HYDRAULICS?

ROBERT VALLIERE
Design Engineer
Morgan Engineering Co.
Alliance, Ohio

About 15,000 *reprints of that booklet were sold out over a year ago. Because there have been hundreds of requests that could not be filled, AH editors have revised the original booklet and will publish it as a part of the January* 1957 *Designer's Guide Issue.*

Arctic Cargo Carrier Depends On T-J Spacemaker CYLINDERS




CIRCULAR HEADS WITH TIE RODS
SQUARE HEADS WITH TIE RODS
40% SPACE SAVED
T-J T-J T-J
T-J SPACEMAKER . . . provides additional room for adjacent equipment without sacrificing strength.

Saves 40% Space!

No Tie Rods For Greater Strength

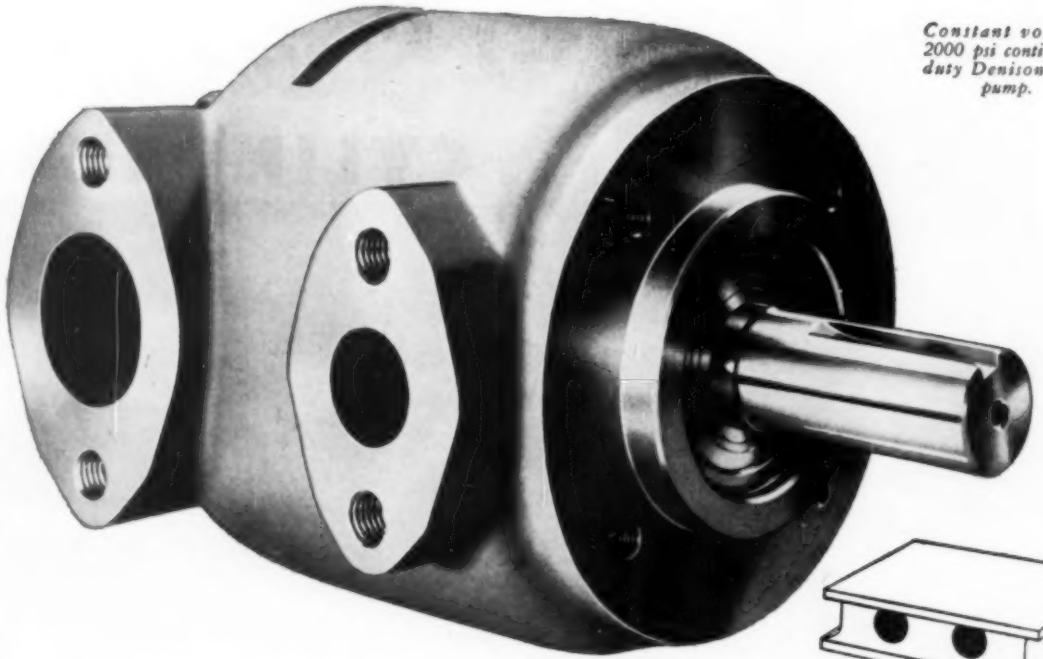
Differential axle loading through T-J Spacemaker Air Cylinders forms a controlled walking beam in this Teracruiser, designed and produced for the Army Ordnance Corps by the Four Wheel Drive Co., Clintonville, Wis.

Weight of cylinders was important factor in choosing T-J Spacemakers, which reduce weight while providing same displacement and extra high safety factor. Fast delivery and space-saving features also favored T-J. Exclusive with T-J are new Super Cushion Flexible Seals for Air (to 200 P.S.I.) . . . and New Self-Aligning Master Cushion for Oil (to 750 P.S.I.). Hard chrome plated bodies and piston rods are standard, at no extra cost. Wide range of styles, capacities . . . 64,000 combinations *off the shelf!* Write for bulletin SM-155-3. The Tomkins-Johnson Co., Jackson, Mich.

ALL MODELS . . . OFF SHELF DELIVERY

MEETS WITH ALL JIC RECOMMENDATIONS

T-J TOMKINS-JOHNSON
RIVETORS AIR AND HYDRAULIC CYLINDERS CUTTERS CLINCHERS



Constant volume 2000 psi continuous duty Denison vane pump.

Hydraulically balanced vane utilizes internal oil pressure to maintain constant pressure of sealing edges against cam ring.

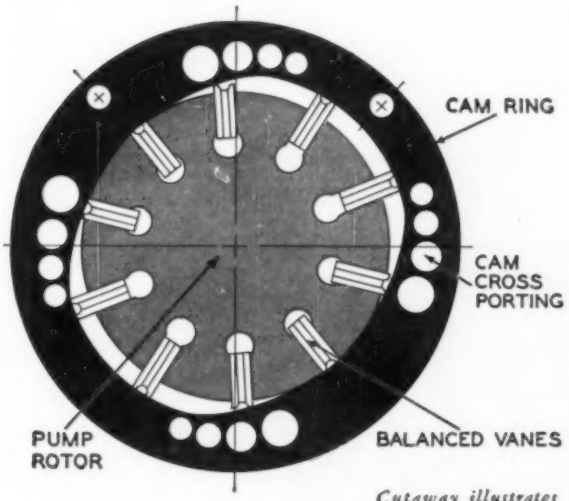
2000 PSI VANE PUMPS

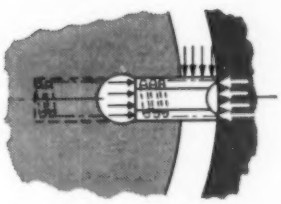
Proper Application
Hydraulic Performance
Operating Characteristics

By Ellis H. Born
Chief Application Engineer
Denison Engineering Division
American Brake Shoe Co.
Columbus, Ohio

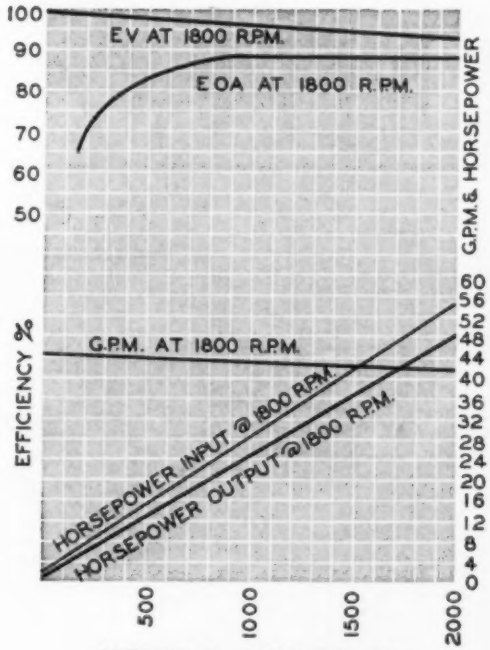
INEFFICIENCIES introduced by line loss are reduced 50% by increasing the pressure from 1000 to 2000 psi.

In designing hydraulic circuits, it is normal to limit line velocities to a maximum of from 15 to 20 feet per second, permitting the use of the smallest practical lines, valves and fittings. The pressure drop in transmitting the fluid medium is thus dependent on flow velocity, number of valves and fittings, and line length. If, for example, the pressure drop of a given system is 50 psi, this would represent a loss in transmission of 5% for a 1000 psi system and a loss of





Cutaway illustrates pump rotor and cam ring assembly. (Below) Pressure balancing relieves hydraulic bearing loads between vanes and cam ring.



Performance Curve of 2000 psi vane type pump illustrates high volumetric efficiency attained with double seal, balanced vane construction.

2.5% for a 2000 psi system. The power lost in transmission is thus reduced 50% by using 2000 psi components.

In sizing components for the transmission of a given horsepower, an interesting comparison of component size, weight and costs can be made. For example, if a job requires the transmission of 16 horsepower, a flow of 16 GPM at 2000 psi working pressure, or 32 GPM at 1000 psi, would be required. Thirty-two GPM would require 1¼" valves, but 16 GPM only ¾" valves. The use of the higher pressure results in a great advantage in that the hydraulic system can be set up with components of lower weight, lower cost per horsepower and smaller, more easily installed pumps, motors and valves.

Additional gains in hydraulic efficiencies are realized by the fully balanced design, not only on the rotor, but on the vanes themselves. Four years of field experience shows that high volumetric efficiencies are maintained over longer periods of service. Wear on cam rings is reduced over conventional designs where the vane is held against the cam ring by hydraulic pressure.

The balanced vane is achieved by a construction allowing the vane to be open at both ends to pressure on the pressure stroke, and to suction on the suction stroke.

Specifications and application data on this vane pump, which also operates as a hydraulic motor, are available by writing.

DENISON ENGINEERING DIVISION
American Brake Shoe Company
1166 Dublin Road, Columbus 16, Ohio

REQUEST FOR APPLICATION DATA

fill out and mail to
DENISON ENGINEERING DIVISION
American Brake Shoe Co.
1166 Dublin Road
Columbus 16, Ohio

Please send specific data on proper application of vane pumps for my needs. Problem is _____

_____

Name of Company _____

City _____ *State* _____

Name _____

Position _____

BRIEFS about fluid power

. . . AT THE 1956 NCIH

Starting on page 107 an AH staff report presents some of the highlights of technical discussions held at the National Conference.

• **Awards Presentation:** Checks were presented to winners of the 1956 APPLIED HYDRAULICS prize paper contest at the Oct. 18th luncheon of the 12th annual National Conference on Industrial Hydraulics in Chicago. "The three top prize winning papers published in October represent outstanding work by the authors in the application of fluid power," said AH's editor, Paul Rolnick, as he introduced the winners to the Conference. Rolnick thanked the contest Judges: H. A. Campbell, Bell Aircraft; Frank Schuster, Allis-Chalmers Industrial Truck Division; and J. J. Yates, General Motors, Detroit Diesel who had tackled the big job of evaluating entries in the contest.

Award winners of the 1956 APPLIED HYDRAULICS Prize Paper Contest receive their prizes from Editor Paul Rolnick. Picture shows left to right: I. Leonard Kaplan, Lax Industrial Products, Inc.; Robert E. Raymond, Simplex Engineering Co.; Paul Rolnick; Paul Maker, Bendix Research Laboratories; and E. L. Dix, Bryant Chucking Grinder Company.

• **1956 Prize Winners:** First prize of $500 went to Paul Maker, Bendix Research and E. L. Dix, Bryant Chucking who co-authored the paper: "How to Apply Closed Loop Hydraulics to Machine Tools". Robert E. Raymond, Simplex Engineering, received the second prize award of $300 for his paper: "New Ideas for Pressure Control". The third prize check of $200 was presented to I. Leonard Kaplan, Lax Industrial Products. He authored the paper: "Proper Use of Relief Valves."

• **1957 Contest:** The 5th Annual Contest was announced at the Conference luncheon. Deadline for entries is July 1, 1957. A Contest Rules Booklet has been published. To obtain a copy, circle number 340 on the Reader Service Card bound in this issue. Judges for the 1957 Contest are top engineers in the mobile equipment, machine tool, and press equipment fields. They are: B. I. Ulinski, Director of Product Research, Automatic Transportation Co.; Earnest Y. Seborg, Development Engineer, The Ingersoll Milling Machine Co.; A. J. deMatteo, Chief Engineer, Watson-Stillman Press Div.

• **NCIH Attendance:** Total attendance to meetings held during the two day conference exceeded 1000. These engineers represented users of hydraulic and pneumatic equipment and designers of components. They came from every part of the country with several from Canada and England.

• **Conference Program:** Robert O. Isenbarger of Chicago Rawhide

Continued on page 20

Bet your boots we make 'em

Steering knuckle drag link boot
Universal joint cover
Bellows cover for sliding ways
C/R
Coated fabric cylinder rod boot
Hydraulic jack cylinder rod boot

Custom-designed and engineered to fit mechanical giants or midgets

Whether you want a boot two stories high . . . or no bigger than your thumb . . . let C/R Sirvis engineers solve the problem for you. They're specialists . . . backed by 78 years' experience . . . with unusual skills and ingenuity in the development and manufacture of mechanical boots. They'll design and produce a C/R Sirvis boot to your exact requirements in any size, any quantity . . . using only the finest materials: mechanical leather, selected, tanned and treated by C/R . . . nylon . . . or elastomer-coated fabric. The absolute dependability of your boot will be proved before production.

So, whenever your problem involves the protection of eccentric, reciprocating or universal action . . . call on C/R. Write us for complete information.

CHICAGO RAWHIDE MANUFACTURING COMPANY
1203 Elston Avenue • Chicago 22, Illinois

Offices in 55 principal cities. See your telephone book.
In Canada: Distributed by Chicago Rawhide Mfg. Co. of Canada, Ltd., Hamilton, Ontario
Export Sales: Geon International Corp., Great Neck, New York

SIRVIS C/R DIVISION
CHICAGO RAWHIDE

Other C/R Products
C/R Shaft & End Face Seals • Sirvene (synthetic rubber) molded pliable parts • C/R Non-metallic Gears

Circle 26 on Reader Service Card

FILTER OUT FERROUS GRIT....

Reduce maintenance costs, parts replacement and downtime

Get rid of iron particles circulating in fluid power circuits before they

1) wear and score precision fitted parts and
2) make valves stick and fail to operate.

FERROFILTER

Magnetic Separators

with a stack of strongly magnetized grids (one shown above), protect hydraulic systems by removing those troublesome particles of rust, scale and other magnetic particles. Standard FERROFILTERS in pipe sizes from ⅜" to 3" operate at 100 psi. High pressure models available up to 5000 psi.

Model PQ-3 for 1" pipe.

Send for BULLETIN PM-65

S. G. FRANTZ CO., Inc.

Brunswick Pike & Kline Ave.
P. O. Box 1138 Trenton 4, N. J.

BRIEFS continued

H. E. Anderson, Minnesota Rubber and Gasket Company and D. N. Allensworth, Parker Appliance Company, discuss features of packings.

Relaxing between sessions are F. D. Wyss, The Paquin Company; R. G. Holt, Char-Lynn Company; and E. H. Schanzlin, Pesco Products Division, Borg-Warner Corp.

D. B. Robinson, taking notes, and Harold Pokorney of Johns-Manville are waiting to attend a technical session.

was Director of this year's program. Twenty-five technical papers were presented in sessions which covered: hydraulics in atomic equipment, pumps, components and accessories, pneumatics, servomechanisms, mobile equipment, machine tools, aircraft systems, fluids, presses, and automotive.

• **Education:** The elevation of the general level of technical knowledge is the major aim of the Conference. This is accomplished by holding the annual meeting and by an educational program of Industrial Hydraulics at Illinois Institute of Technology under the auspices of NCIH.

Dr. Frank D. Carvin of Illinois Tech was named Conference Director for 1957. The 13th annual National Conference on Industrial Hydraulics will be held October 17 and 18, 1957 at the Hotel Sherman, Chicago. Raymond D. Meade is Conference Secretary.

To date about 350 students have taken the industrial hydraulics

Continued on page 22

Now... Local Availability on

Titeflex

Seal-Tight, Time-Saving

Quick-Seal Couplings

Titeflex Couplings are *leakproof* at *all* operating pressures—the higher the pressure the tighter the seal! Couple or uncouple in ONE second... without the aid of tools. Straight-through or single or double check-valve types. Allow free flow of *any* viscous material. Sizes from ¼" to 12" diameter. Made from a variety of metals and alloys to suit innumerable industrial applications.

Titeflex

Flexible Metal Hose

—the ideal "conveying mate" for Titeflex Couplings. Withstands high temperature and pressure stresses. Impervious to vibration and corrosive action.

Both these time-tested products are available for immediate shipment from distributors' stocks in most areas. Otherwise write, wire or telephone direct.

CALL YOUR LOCAL DISTRIBUTOR

Consult the yellow pages of your telephone directory

Your one source for both Hose and Couplings

Titeflex

TITEFLEX, INC., 601 HENDEE STREET, SPRINGFIELD 4, MASS.

PRECISION

PRESSURE REGULATORS

14 models to meet almost all industrial needs.

Send for free catalog.

GOVERNAIRE-pilot operated
KENDALL-direct acting

Now available from the Stratos Industrial Products Branch are two complementary lines of pneumatic pressure regulating valves. Both lines are designed for dead end service. Relief is built in and air consumption is low.

▲ The **Governaire**: Offering very high flows regulated by small signals, the "Governaire" models are self-contained pilot operated, giving precise control even at very large flow rates. (Illustrated is the lever-operated Model 3500).

◀ The **Kendall**: Direct acting, force balanced types, the "Kendall" regulating valves also are available in a wide flow range. They offer the reliability in the direct acting type that the "Governaire" models give in the pilot-operated type.

All models can be completely serviced – including replacement of working parts – without removal from the line. Most are designed for operation at up to 250 psi supply pressure.

AVAILABLE MODELS

GOVERNAIRE

Regulators Model No.	Regulated Pressure Range	Pipe Sizes
1000	½–10 to 2-150	¼ & ⅜ NPT
3500 (Drift-free Lever Set)	½–30 to 3-150	⅜, ½ & ¾ NPT
4000	½–10 to 5-250	⅜, ½ & ¾ NPT
Volume Boosters		
1500 (spring biased)	½–10 to 2-150	⅜, ½ & ¾ NPT
	Ratio	
2000	1:1	¼ & ⅜ NPT
4500	1:1, 1:2, 1:3 2:1 & 3:1	⅜, ½ & ¾ NPT
2500 (reversing relay)	1:1 & 1:3	½ & ¾ NPT

KENDALL

Regulators Model No.	Regulated Pressure Range	Pipe Size
10	½–30 to 2-150	¼ & ⅜ NPT
30 (miniaturized)	½–30 to 2-100	¼ & ⅜ NPT
50	20 psi set	¼ NPT
55	0–10 to 2-100	¼ NPT
Volume Boosters Model No.	Range	Pipe Size
15	0–10 to 2-150	¼ NPT
	Ratio	
20	1:1, 1:2, 1:3 2:1 and 3:1	¼ NPT
25 (reversing relay)	1:1	¼ NPT

STRATOS
INDUSTRIAL PRODUCTS BRANCH
A Division of Fairchild Engine and Airplane Corporation
Route 109, West Babylon, Long Island, N. Y.

BRIEFS / continued

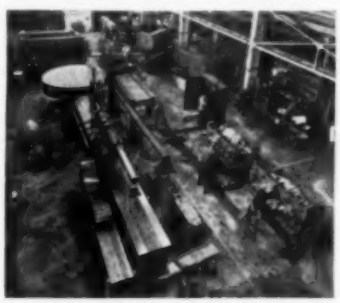
course offered at Illinois Tech. Repeated during the summer on a full time basis, eight hours daily, five days per week, the course is covered in two weeks. Requirements are high school graduation and present connection with oil hydraulic industry. Cost is $100.

▼▼▼

Hydraulic Power On Radial Draw Former

Lockheed Aircraft Corporation will employ in the production of major contoured structural parts, including skin sections—for the 7 mile-a-minute propjet airliner Electra—a 75 ton radial draw former built by the Cyril Bath Company.

• **Four Units**—Basically the machine consists of the rotary table with a diameter of 120 inches; the

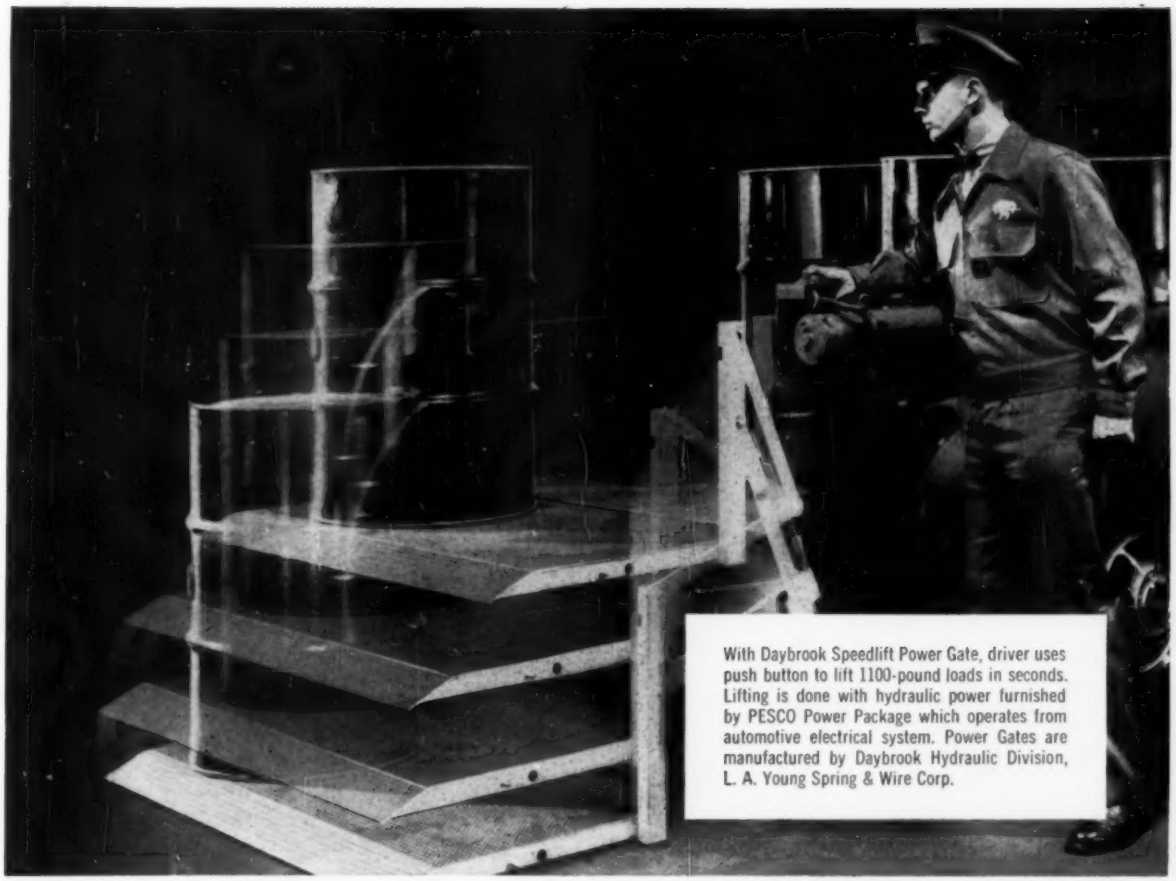


Hydraulic control panel assemblies, together with motors and pumps which actuate the hydraulic controls for main stretch ram and traversing wipe shoe, are shown on the right. Electric control panel, with opened door, gives operator remote control of all machine movements.

hydraulic stretching ram and gripper head, with a stretch capacity of 50 tons; the gripper head which is attached to the rotary table; and the traversing wipe shoe, which has a pressure capacity of 25 tons.

• **Controlled Pressure**—During the forming cycle of the piece a controlled pressure is maintained, both in the longitudinal stretch, effected by the main stretching ram, and the tangential-

Continued on page 26



With Daybrook Speedlift Power Gate, driver uses push button to lift 1100-pound loads in seconds. Lifting is done with hydraulic power furnished by PESCO Power Package which operates from automotive electrical system. Power Gates are manufactured by Daybrook Hydraulic Division, L. A. Young Spring & Wire Corp.

hydraulic power at the push of a button

...with self-contained Pesco package

If you need to produce hydraulic power from an electrical source, investigate PESCO's line of Hydraulic Power Packages.

These low-cost units are versatile and find extensive application on tailgate loaders, lift trucks, small dump bodies, farm tractors and snow plows. They provide hydraulic flow to .80 gpm at pressures to 2000 psi from any suitable 6, 12 or 24-volt d-c source.

PESCO Hydraulic Power Packages include an electric motor, hydraulic gear pump with integral relief valve, check valve and reservoir in a single, self-contained assembly. The PESCO gear pump features "Pressure Loaded"* bearings for higher volumetric efficiency and longer service life.

Original equipment manufacturers are invited to obtain price quotations or specific information from your nearest PESCO sales engineer or write: PESCO, 24700 North Miles Road, Bedford, Ohio.

PESCO HYDRAULIC POWER PACKAGE converts electrical power to hydraulic, finds wide industrial use. Compact "package" design contains motor-driven gear pump, relief and check valves and reservoir.

See our catalog in Sweet's Product Design File

PESCO PRODUCTS DIVISION
BORG-WARNER CORPORATION
24700 NORTH MILES ROAD • BEDFORD, OHIO

Producing the Best in Hydraulic Pumps, Fuel Pumps, Electric Motors and Axial Flow Blowers

**PESCO's patented principle of gear pump construction*

1957 FLUID POWER PRIZE PAPER CONTEST

for

Articles About: Pneumatic and Hydraulic Systems and Componets

DESIGN • APPLICATION • MAINTENANCE

First Prize $500

Second Prize $300

Third Prize $200

4th to 7th Prizes, each $50

5th Annual Competition

All prize papers will be published in APPLIED HYDRAULICS Magazine. Papers receiving honorable mention awards will also be published during 1958 and paid for at regular rates.

CONTEST CLOSES JULY 1, 1957

SPONSORED BY

APPLIED HYDRAULICS

An Industrial Publishing Corp. Magazine

812 HURON ROAD

CLEVELAND 15, OHIO

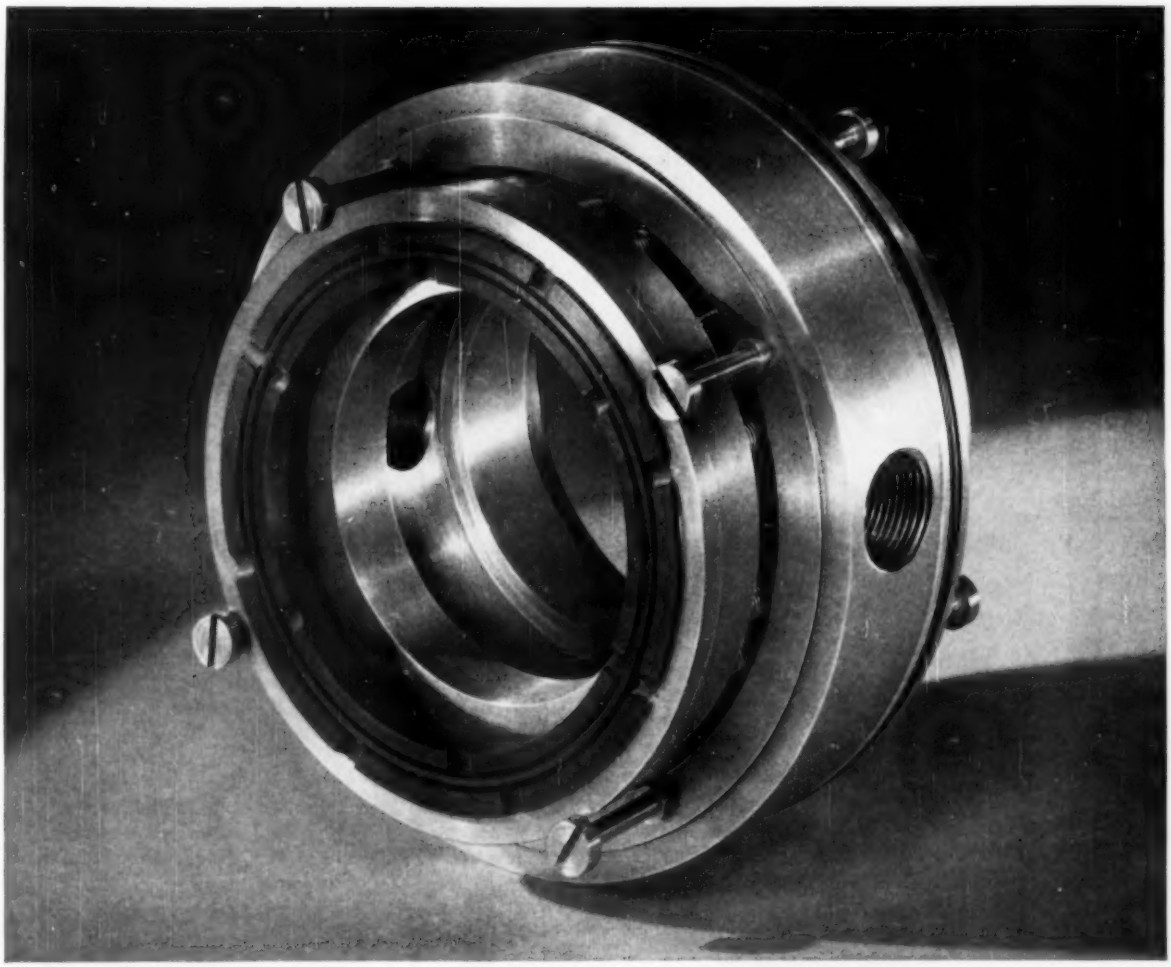
Committee of Judges:

B. I. Ulinski, *Director Product Research*
Automatic Transportation Co.
Chicago, Illinois

Earnest Y. Seborg, *Development Engineer*
The Ingersoll Milling Machine Co.
Rockford, Illinois

A. J. DeMatteo, *Chief Engineer*
Watson-Stillman Press Div.
Farrel-Birmingham Co., Inc.
Roselle, New Jersey

TO RECEIVE A CONTEST RULES BOOKLET CIRCLE 340 ON READER SERVICE CARD



Koppers Face Type Seal Provides Up to 20,000 Hours of Service!

Up to 30,000 Hours in Laboratory Tests Using Clean Gas!

Koppers engineering has created an unmatched sealing surface that gives Koppers Face Type Seals a much longer-than-ordinary service life.

The exclusive design of the sealing surface keeps pressure distribution and hydraulic balance unchanged during operation . . . permits a light face loading which lowers interface temperatures. Hydraulic balance allows sealing of gases and liquids through a wide range of rubbing speeds. Rugged construction adds to Koppers long service life. Rotating collars can be of hardenable stainless steels, cutlery and die steels, Stellites, or of a hard chromium or carbide face. Ring is of carefully selected grades of carbon.

If you have a sealing or piston ring problem, Koppers entire research, production and engineering facilities are at your disposal. For more details, write to the KOPPERS COMPANY, INC., 1512 Hamburg St., Baltimore 3, Maryland.

Koppers Company, Inc.
Metal Products Division
Piston Ring and Seal Dept.

***Engineered* Products**
Sold with *Service*

KOPPERS

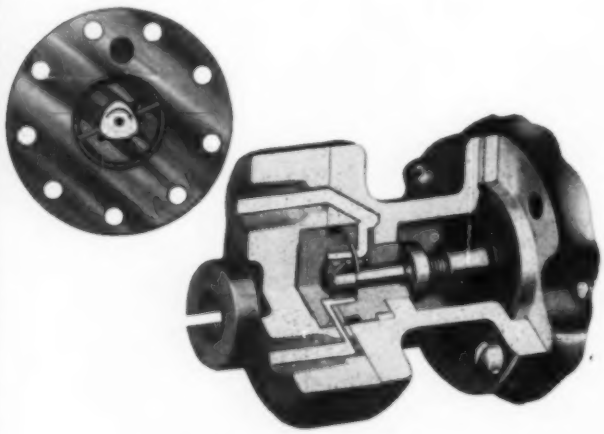
MECHANICAL SHAFT SEALS

Circle 57 on Reader Service Card

WELDON

FLUID METERING PUMPS

Positive Displacement Rotor Type. For Industrial Applications, Aircraft Anti-Icing and Aircraft Fuel.



IT'S SO SIMPLE!

The rotation of the rotor draws the fluid in through two passages, filling the cavities formed by the three lobes of the rotor. This fluid is sealed within these small cavities until it is forced through the two outlet holes by the floating blades. The flow may be kept uniformly divided through two outlet ports, or may be combined internally for passage through a single port.

Compact • Light Weight

Send for Weldon Manual and Catalog with detailed specifications and installation drawings, covering the full range of Weldon pumps in various capacities. Specify your requirements.

THE WELDON TOOL COMPANY

3000 WOODHILL ROAD · · · CLEVELAND 4, OHIO

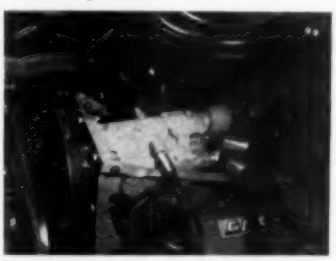
BRIEFS continued

ly applied pressure of the traversing wipe shoe. The revolving table has ample spindle to withstand the lateral thrusts and tensions exerted by the stretching and planishing hydraulic pressures upon the table.

• **Remote Control**—An electric control panel gives the operator remote control of all movements of the machine which can form all angles from the straight to the full 360 degrees. ▼▼▼

Constant Speed Truck Refrigeration Drive

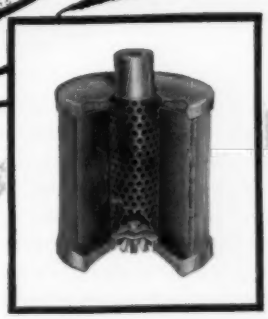
• **Three small units**—Sundstrand Hydraulics Division has developed this drive which consists of a hydraulic pump, a 1½ qt oil reservoir including a filter, and the fluid motor which drives the compressor. While the input speed of the engine drive to the pump may vary in a range from 450 to 3000 rpm, the output speed of the fluid motor will hold constant at 1800 rpm, within a range of 200 rpm.



• **Operating Features**—Specifically designed for truck refrigeration, the unit will deliver up to 3 hp continuously. Automatic temperature control is possible by connection to the cooling system thermostat. The system is easy on the battery because the engine can be started with no load imposed by the pump. A built-in delay in the hydraulic system starts the compressor smoothly without jerking. Full refrigeration capacity is available at all truck engine speeds with a considerable saving in space and weight through the elimination of the auxiliary gas engine. ▼▼▼

Continued on page 28

KEEP IT CLEAN...
by Phil Tration



MODEL HE HYDRAULIC FILTER

The uses for Dollinger Filters are truly "elephantine" . . . any liquid, gas, or air can be efficiently and economically handled by them.

The Staynew Hydraulic Filter protects sump pumps on hydraulically operated equipment . . . eliminates damage caused by abrasive particles, reduces spoilage and rejects caused by unclean cutting lubricants.

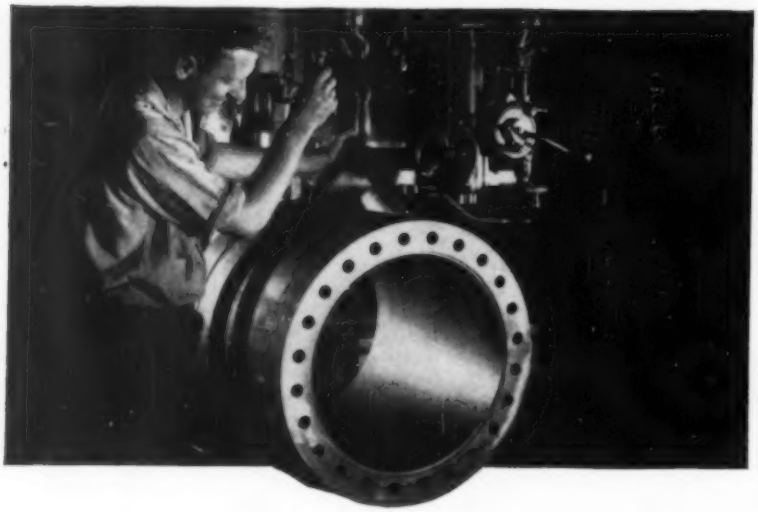
Compact, simple, efficient Staynew Hydraulic filters are used wherever dirty liquids are collected, filtered and re-circulated. Its unique Radial Fin design permits the largest filtering area in the smallest possible space—back pressure is reduced to a minimum, and long operation is assured without cleaning or replacement. Entire unit may be disassembled for cleaning in 30 seconds.

Write for Bulletin 300 which contains complete engineering data on Staynew Hydraulic Filters. Dollinger Corporation, 65 Centre Park, Rochester 3, N.Y.

DOLLINGER
STAYNEW FILTERS

LIQUID FILTERS • PIPE LINE FILTERS • INTAKE FILTERS • HYDRAULIC FILTERS
ELECTROSTATIC FILTERS • DRY PANEL FILTERS • SPECIAL DESIGN FILTERS
VISCOUS PANEL FILTERS • LOW PRESSURE FILTERS • HIGH PRESSURE FILTERS
AUTOMATIC VENTILATION FILTERS • NATURAL GAS FILTERS • SILENCER FILTERS

Tubular stock or finished components centrifugally cast by SHENANGO!



IN tough hydraulic service Shenango's *centrifugal casting process* solves many a cost and performance problem . . . greater strength, improved wear resistance, avoidance of inclusions and porosity, fewer rejects, faster finishing with excellent surface characteristics. And Shenango can serve you quickly and well with either rough machined tubular *stock* or *completely finished symmetrical components!*

Tubular Stock: Bronze or high strength Meehanite Metal. Full range in O.D. and I.D. Choice of lengths cut to minimize production waste.

Finished Components: Special cylinders and other symmetrical parts and assemblies, small or large, ferrous or nonferrous, skillfully produced precisely to your specifications.

For helpful bulletins or sales-engineering service write to Centrifugally Cast Products Division, The Shenango Furnace Company, Dover, Ohio.

SHENANGO CENTRIFUGAL CASTINGS

COPPER, TIN, LEAD, ZINC BRONZES • ALUMINUM AND MANGANESE BRONZES
MONEL METAL • NI-RESIST • MEEHANITE METAL • ALLOY IRONS

BRIEFS continued

British Aircraft Engineering Show

In British Aviation circles the Society of British Aircraft Constructors Flying Display and Exhibition is the highlight of the year. The 1956 event, staged at Farnborough, England, provided a large and varied exhibition of aircraft, accessories and components, along with flying displays of the latest civil, military and experimental aircraft.

• **Components and Accessories**—An improved version of the Vardel 4000 psi hydraulic piston pump was shown by Dowty Equipment Ltd. This new design incorporates a wave filter to smooth out pulsations in the delivery and to ensure a ripple-free flow. This has succeeded in reducing the amplitude of "ripple" to less than 100 psi throughout the whole speed range of the pump without reducing the maximum pressure at full output.

A completely self-contained unit, consisting of a portable oil pump and filter, for the purpose of filtering oils used in hydraulic systems before, during or after ground operation, was displayed by Exactor Ltd. The capacity of this unit is 100 gallons per hour, its maximum output pressure is 20 psi and it is capable of filtration down to 5 microns.

The Lockheed Avery exhibit included their range of self-sealing couplings which eliminate the necessity for draining systems before disconnection. Working pressures of up to 4000 psi are permitted according to the size and type of coupling.

• **Synthetic Materials**—Requirements of ultra-sonic and super altitude flight demanded by both manned and pilotless aircraft, as well as the wide range of guided missiles, have necessitated flexible pipe lines capable of carrying very high pressures and at the same time withstanding temperatures ranging from +500 degrees F to −150 degrees F. Bowden (Engineers) Ltd. have for this purpose developed new plas-

Continued on page 30

Naugatuck PARACRIL

The oil-resistant nitrile rubber

"...the rubber we know will resist 'em all!"

"We can't be sure just what kind of oil or other hydraulic fluid will be in contact with our hydraulic hose liners, pressure seals and accumulator bladders, so we use the rubber we know will resist 'em all!" That was the reply when one manufacturer of rubber products was asked about his choice of PARACRIL® for rubber hydraulic specialties.

"In addition, PARACRIL gives us the low-temperature flexibility and other properties needed to meet government specs. The broad range of PARACRIL types enables us to achieve, at low cost, almost any combination of oil resistance and required physicals. We also use PARACRIL for lining our gasoline, fuel oil and liquid petroleum gas hose because of its superior resistance to aromatic hydrocarbons."

Whenever softening or swelling of rubber in contact with oil may decrease efficiency or shorten service life, designers and users alike will do well to specify PARACRIL. Extensive literature on PARACRIL nitrile rubber is now available. Write us the exact nature of your interest in oil- and grease-resistant rubber and we'll gladly send you, without cost, the pertinent technical bulletins.

Naugatuck Chemical

Division of United States Rubber Company
Naugatuck, Connecticut

IN CANADA: NAUGATUCK CHEMICALS DIVISION • Dominion Rubber Company, Limited, Elmira, Ontario • Rubber Chemicals • Synthetic Rubber • Plastics • Agricultural Chemicals • Reclaimed Rubber • Latices • Cable Address: Rubexport, N.Y.

Circle 109 on Reader Service Card

the **NEW**

USG **SOLFRUNT®**

(SOLID FRONT CONSTRUCTION)

the gauge with

BUILT-IN SAFETY!

There's safety with the new USG Solfrunt Gauge . . . behind the face is a solid metal wall! In the event of a Bourdon tube rupture, pressure is released through the large rubber blowout back. The case is of aluminum.

Like USG's Supergauge . . . with proper application . . . the Solfrunt is built to last a lifetime.

ARC-LOC MOVEMENT—Rugged beyond compare . . . broad generated gear faces, deep stainless steel bushings. Calibration adjustments from rear by merely removing blowout back.

SEGMENT—Stainless steel, with nylon-faced gear section. Nylon-to-metal bond stabilizes the nylon against expansion and contraction . . . maintains accurate pitch diameter . . . assures proper mesh with stainless steel pinion under severe temperature and moisture conditions.

LEGEND ON DIAL—gives complete description of socket, Bourdon tube, and movement material for ready identification.

MICROMETER ADJUSTABLE SELF-LOCKING POINTER—permits accurate repositioning of pointer.

Solfrunt Gauges available in 4½", 6" and 8½" sizes. For complete information on case styles, materials of construction and connections, write for Publication 1819.

UNITED STATES GAUGE

Division of American Machine and Metals, Inc.

Sellersville, Pa.

Home of the **SUPERGAUGE**

BRIEFS continued

tic linings for hose and hose assemblies.

Laboratory developments at the Ronald Trist Co., Ltd., have enabled this company to produce synthetic and silicone rubbers, and nylon materials from which they are now producing packings and seals for a wide temperature range.

A new rubber-like material in the Polyester class of rubbers, called Prescollan, has been evolved by Precision Rubbers Ltd. Among its characteristics, this material has resistance to oils, good electrical properties and a fair compression set.

• **Controls**—Short Bros. & Harland Ltd. demonstrated a system of power operated flying controls. This power-operated elevator control was linked electronically to an analog computer and also to a servo controlled rocking table. In this manner a pre-set signal could be fed into the computer which then transmitted it to the hydraulic power flying control, at the same time the movement of the aircraft responding to the signal was reproduced on the servo-controlled rocking table.

Another development in connection with hydraulic power flying controls was the auto stabilization which was demonstrated on a scale model at the Hobson exhibit. Use of modern power flying controls makes it sometimes difficult for the pilot to correct unwanted movements, either longitudinal or lateral, and to assist in steadying the aircraft, a gyro-stabilizer is employed to feed signals through an electronic device which are then superimposed on the hydraulic valve of the power flying control. J.A.L. ▼▼▼

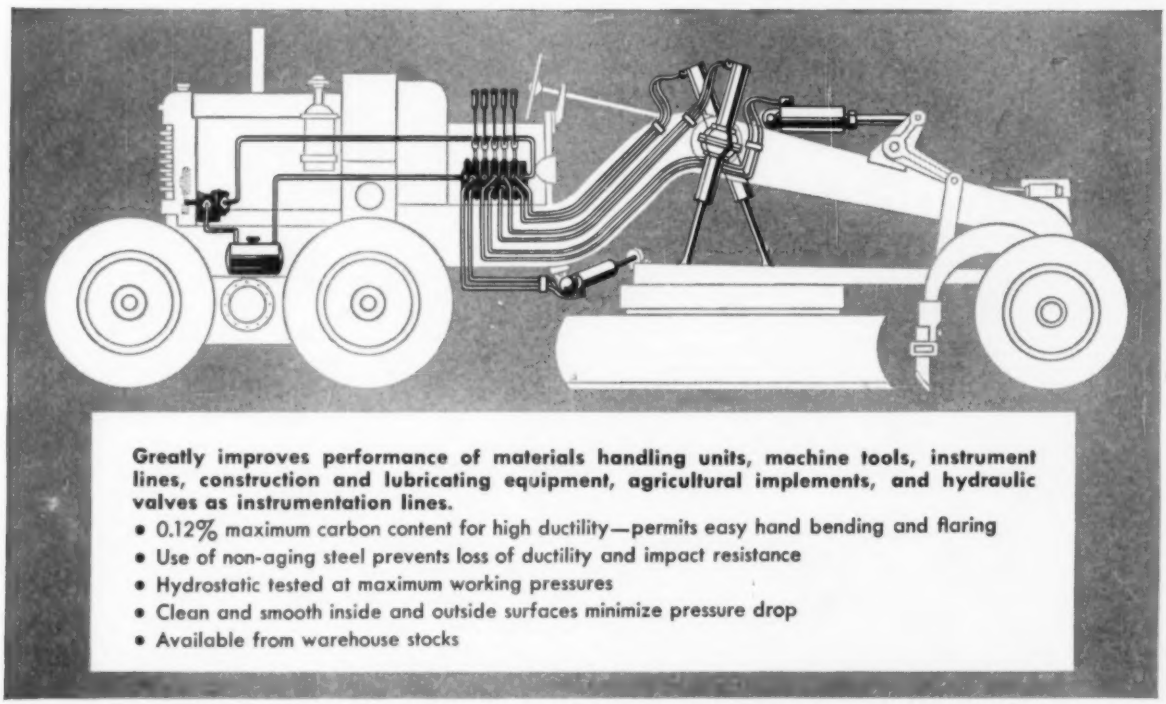
NILA Announces 1957 Officers

At the National Industrial Leather Association's annual meeting, 1957 officers were elected. W. H. Chestnut, Mechanical Leathers, Inc., Philadelphia, president; John

Continued on page 35

5 BIG REASONS

SUPERIOR SAE HYDRAULIC TUBING PRACTICALLY ELIMINATES TUBING FAILURE



Greatly improves performance of materials handling units, machine tools, instrument lines, construction and lubricating equipment, agricultural implements, and hydraulic valves as instrumentation lines.

- 0.12% maximum carbon content for high ductility—permits easy hand bending and flaring
- Use of non-aging steel prevents loss of ductility and impact resistance
- Hydrostatic tested at maximum working pressures
- Clean and smooth inside and outside surfaces minimize pressure drop
- Available from warehouse stocks

This motor grader is one of the many types of mechanized equipment that use Superior SAE Hydraulic Low Carbon Steel Tubing.

Superior SAE Hydraulic Low Carbon Steel Tubing is made from a carefully controlled non-aging type of steel which will not harden in storage or use. Aging and precipitation hardening are changes in properties that some steels undergo at atmospheric or moderately elevated temperatures after cooling or cold working. These take place even where steel is stored at room temperature, though at a slower rate.

Superior SAE Tubing, whether in storage or operation, will maintain the yield strength, elongation and ductility it has when shipped from the mill.

Superior SAE Hydraulic Tubing is available from distributor warehouse stocks or mill produced to your order in long coils.

Send for a copy of Bulletin 39, containing detailed information on the uses and advantages of Superior SAE Hydraulic Tubing. Write Superior Tube Company, 2030 Germantown Ave., Norristown, Pa.

Superior Tube

The big name in small tubing

NORRISTOWN, PA.

All analyses .010" to ⅝" OD—Certain analyses in light walls up to 2½" OD

On the West Coast: Pacific Tube Company, 5710 Smithway St., Los Angeles 22, Calif.

1. Hook seal around shaft. Spread seal apart and slide over shaft.
Reduce downtime...
2. Tuck spring in groove using two flat paddles made from welding rods.
3. Lubricate shaft and push seal home with paddles or screwdriver.

How J-M Split Clipper Seals speed installation

. . . flexible body provides easy installation and removal even with small clearances

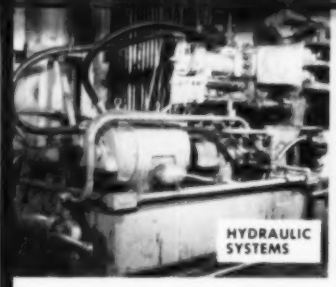
"Downtime" is measured in seconds when Clipper Seals do your sealing. Furnished in split form and made from a highly flexible synthetic rubber compound, they can be readily slipped into the tightest spots. Neither special training nor special tools are required . . . no drilling and tapping for cover plates is necessary because cover plates are not needed.

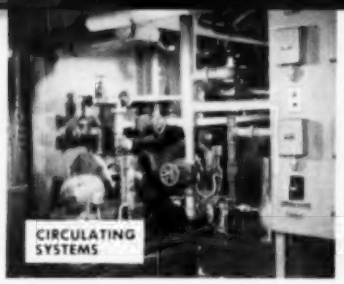
Clipper Seals are virtually fracture-proof and stand up well under rough handling by inexperienced mechanics. The self-adjusting garter spring has a hook and eye which is easily hooked around the shaft. It is then a simple procedure to slip it into the groove. When the shaft end is accessible, solid seals are used and snap into place almost as quickly as you can say "Clipper Seal." What's more, they stay put.

Reduced "downtime" is only one of many advantages you get with J-M Clipper Seals. Precision moulded from a variety of corrosion-resistant compounds specially developed for each service, they provide maximum sealing ability, low torque, long life and wide adaptability. For more information on the complete line of Clipper Seals, write for new 28-page illustrated brochure PK-71A. Address Johns-Manville, Box 14 New York 16, New York. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville CLIPPER SEALS

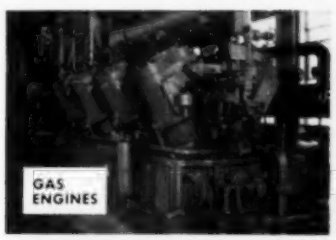


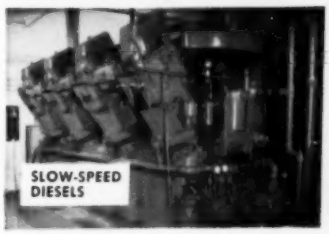


SUN SOLNUS OILS IDEAL LUBRICANTS FOR 80% OF ALL APPLICATIONS

Moderately priced...low in carbon-forming tendencies, Sun Solnus® oils simplify your storage problems by doing with *one oil* many jobs that would otherwise require *several.* Their ability to protect metal parts against corrosion, their resistance to oxidation, and their moderate price all add up to "more lubrication per dollar."

For technical information, see your Sun representative, or write to SUN OIL COMPANY, Philadelphia 3, Pa., Dept. I-51.





SUNOCO®

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY

PHILADELPHIA 3, PA.

© SUN OIL CO.

In Canada: SUN OIL COMPANY LIMITED, Toronto and Montreal

Valve on left is from compressor run for 3,000 hours with well-known, high-grade oil. At right is same valve after a 3,000-hour run with Sun Solnus oil. Note difference in carbon deposits.

3000-HOUR TEST PROVES SUN SOLNUS OILS REDUCE CARBON BUILD-UP IN COMPRESSORS

Equipment: A three-stage Norwalk horizontal-type compressor. Operating pressure: from 1,000 to 1,500 psi.

Test: The compressor was cleaned thoroughly and filled with a well-known, high-grade oil. The equipment was run for 3,000 hours, then torn down for inspection and cleaning. Then Solnus® 300 was tested in the same way.

Results: Look at the two pictures. You can see for yourself how Solnus oil reduced dangerous carbon build-up.

All types of reciprocating air compressors that have been changed over to a Sun Solnus oil show similar results. A test in your compressor will show the same remarkable reduction of carbon deposits.

You can get a technical bulletin about Sun Solnus oils by asking your Sun representative, or write to SUN OIL COMPANY, Philadelphia 3, Pa., Dept. I-52.

SUNOCO®

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY PHILADELPHIA 3, PA.

© SUN OIL CO.

IN CANADA: SUN OIL COMPANY LIMITED, TORONTO AND MONTREAL

BRIEFS continued

R. Lovett, Cleveland Oak Belting Co., Cleveland, vice president; and A. B. Laurence, Laurence Belting Co., New York, treasurer. E. R. Rath was re-elected executive vice president and secretary. The three new directors elected to the board are Wm. F. MacDonald, E. F. Houghton & Co., Philadelphia; Harry L. Northup, Chicago Rawhide Mfg. Co., Chicago; and Julius A. Schachner, Jr., Schachner Leather & Belting Co., Charlotte.

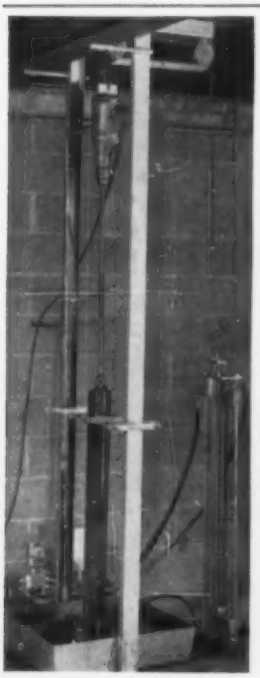
The Mechanical Leather Packing Division elected Alfred S. Berens, Chicago Rawhide Mfg. Co., chairman and Robert D. Hapka, Albert Trostel Packings, Ltd., Lake Geneva, Wis., vice chairman. ▼▼▼

Emergency Power Unit For Jet Plane

• **Drop-out type**—To supply both electrical—alternating and direct current—and hydraulic power, sufficient to maintain flight control and communications through all speeds from supersonic down to safe landing, Marquardt Aircraft Company has developed and produced this ram-

air turbine. Chance Vought's F8U-1 Crusader has been equipped with this unit. A trigger control pushes the turbine out into the air stream and the fan starts rotating immediately to drive the hydraulic pump and the electrical generator. Weight of the complete power package is less than 50 seconds. ▼▼▼

Continued on next page



To eliminate some of the tiresome and fatiguing operations on the average manually operated hone, Munton Mfg. Co. has developed a semi-automatic vertical honing machine. Illustration shows cylinder being honed on this unit, which is electro-hydraulically operated with a ½ or ¾ hp 110 v 60 cyc motor. Length of stroke is adjustable from 0 to 36 inches. A shut-off valve stops stroke for adjusting of tension on stones. Instant reversing at top and bottom of stroke eliminates bell-mouthing. The unit is suitable for wet or dry honing.

PERFORMANCE

• SMOOTH • POWERFUL
• DEPENDABLE

O-M

CYLINDERS
TIE-RODLESS

• air and hydraulic
• meet JIC standards

O-M Tie-rodless Air and Hydraulic Cylinders deliver peak performance at low or high speeds. They are simple and unique in design . . . have no tie rods or projecting end caps . . . fit easily in unusually close quarters . . . operate with lowest co-efficient of friction . . . and are readily disassembled for servicing. Besides, the ports can be oriented to any position. Interchangeable mounts make O-M Cylinders adaptable to any installation. All cylinders tested at rated operating pressures before shipment.

Available in full range of sizes (1½" to 8" bores) with standard, 2 to 1 or oversize rods.

Write TODAY for BULLETIN 101A

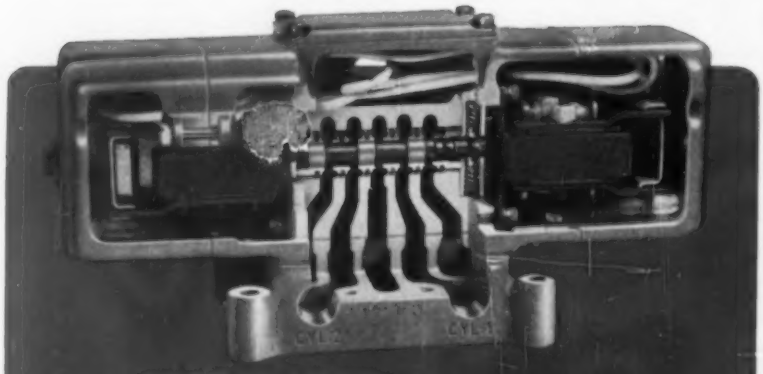
MAIL COUPON NOW!

ORTMAN-MILLER MACHINE COMPANY
1 143rd Street, Hammond, Indiana

☐ Have Representative call
☐ Send Bulletin 101A (Round Line)

Name_____ Position_____
Company_____
Address_____
City_____ Zone___ State_____

something NEW!



a BETTER air valve

Patent Pending

. . . the SA series

NEW SIMPLICITY . . . a lapped spool sliding in a hardened sleeve provides the valving action—*One moving part.*

NEW RELIABILITY . . . the valve has no moving seals; eliminates wear, sticking, swelling of elastic seals. Gives positive, trouble-free performance.

NEW RUGGEDNESS . . . the SA Series sets new standards for long life. Outwears ordinary valves on every test.

NEW DESIGN . . . full sub-plate mounting, watertight solenoid enclosures, integral junction boxes on all double solenoid models, side ports, bottom ports, O-ring manifold mount . . . all are standard on the SA Series.

The SA Series offers a complete line of actions, single solenoid spring return, double solenoid momentary contact and double solenoid spring centered 4-way actions . . . single and dual pressure versions. 54 different models in sizes ¼" through ¾" pipe. The most complete family of 4-way air valves available.

Get complete information and specifications by mailing the coupon.

NUMATICS, Inc. MILFORD, MICHIGAN

NUMATICS Inc.
106 Main Street, Dept. AH
Milford, Michigan

Send me your catalog No. 8000 on the new SA Series Valves.

NAME_____

COMPANY_____

ADDRESS_____

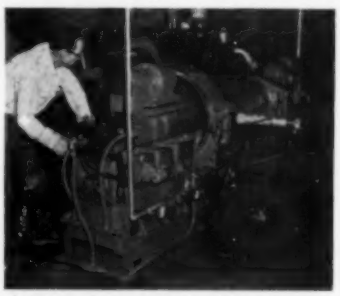
CITY_____ ZONE_____ STATE_____

BRIEFS continued

Trimming Machine Uses Pneumatic System

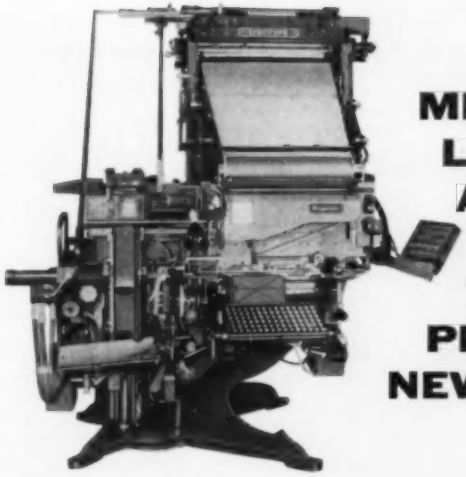
• **Higher Production Rate**—Only simple loading and unloading operations are required by a trimming machine developed by Pastushin Aviation Corp. The machine, one of several units in a conveyorized fabrication and assembly line, achieves a production rate of 200 external jettisonable fuel tanks an hour with only 48 people working on the line in a single shift.

• **Semi-Automatic Operation**—After forming to a complex-contoured shape, the tank tail



skins are conveyed to the trim machine, positioned and clamped in place by half-rings which are pneumatically operated. The machine is automatically sequenced so that after the operator has placed the skin on the machine and operated the holding clamps to the closed position, a flycutter, expanded by a pneumatic cylinder, moves into position at each end and trims the skin from the inside. The flycutter head is driven by an electric gearhead motor. After the flycutter has cut through the skin a solenoid air valve retracts the flycutter to its basic position. Turning heads are automatically stopped and the clamping mechanism opened to allow operator to remove the skin. The pneumatic system utilizes manually and electrically operated air valves with filter, water trap, pressure regulator and gauge. A small accumulator is placed in the air line at the entrance to the machine to smooth pneumatic operation.

▼▼▼



MERGENTHALER LINOTYPE ASSURES PRECISE TROUBLEFREE PRESSURE IN NEW HYDRAQUADDER

Smooth, troublefree hydraulic operation is the key to superior performance of the Hydraquadder — Mergenthaler Linotype Company's unique development that cuts the cost of setting type centered, flush left, or flush right as much as 45%. Pressure for the Hydraquadder is maintained by a Brown & Sharpe special, rotary-geared pump (see below) powered by the Linotype's main driving gear. The Hydraquadder automatically positions type matrices (molds) under low pressure, then smoothly exerts a high pressure grip for casting. There is no mechanical linkage; no slap. Pressure is uniform regardless of line length. And successful installations of the unit over a two-year period have proved its ability to operate with sustained high accuracy . . . practically no maintenance.

This is a performance record typical of the many hydraulic applications of Brown & Sharpe special pumps. If *your* pumping problem involves hydraulics, cooling, lubrication, or other transfer of industrial liquids, let us hear about it. Write Brown & Sharpe Mfg. Co., Providence, R. I.

...with Brown & Sharpe special pump

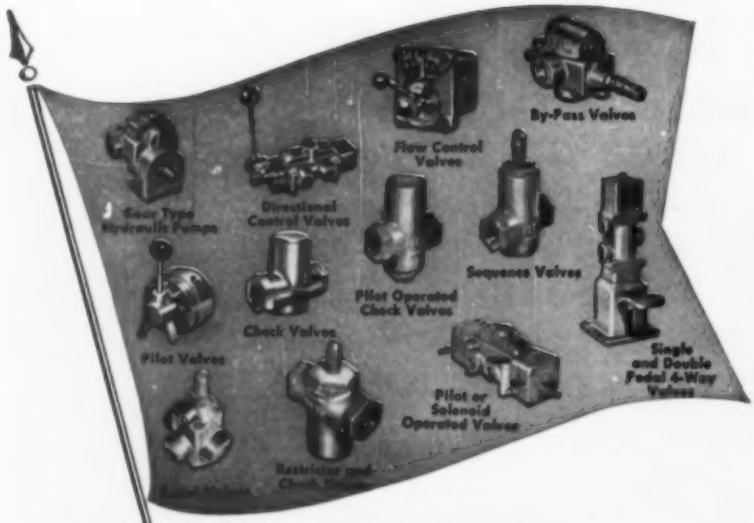
Small, compact Brown & Sharpe special rotary-geared pump, powered by Linotype's main driving gear maintains Hydraquadder pressure. The pump is rated at 225 psi, has needle-bearings, and is self-lubricated. Like all Brown & Sharpe pumps, its gears are case-hardened to full 1/32" depth for extra stamina.

B·S

Brown & Sharpe

BUY THROUGH YOUR LOCAL DISTRIBUTOR

PUMPS FOR TOP PERFORMANCE UNDER PRESSURE



BY ANY STANDARD...

ADEL *Refinements* assure Plus Performance for Your Equipment

Designers and Engineers have set these standards for Industrial Hydraulic Equipment

Rugged simplicity • Long life • Simplification of piping • Reduced installation costs • Greater accessibility for maintenance • Completeness of line • Over-all economy

ADEL brings them all to you!

Smooth economical hydraulic power for Pushing, Pulling, Lifting, Pressing, Clamping and Controlling.

Illustrated are but a few of a wide variety of ADEL industrial hydraulic control equipment that offer definite benefits to both the user and builder of machine tools and many other kinds of equipment. ADEL products incorporate proven design and precision construction features that assure dependable operating efficiency over the years. A complete line for every application. You can simplify your Hydraulic Power Motion Problems by specifying ADEL.

For complete engineering specifications and counsel, Address: ADEL DIVISION, GENERAL METALS CORPORATION, 10771 Van Owen Street, Burbank, California

ADEL
PRECISION PRODUCTS
A DIVISION OF GENERAL METALS CORPORATION

Manufacturers of Industrial Hydraulic Control Equipment

DISTRIBUTORS: AIR-DRAULIC EQUIPMENT CO., HOUSTON, TEX. • AIR & HYDRAULIC ENGINEERING CO., NEW HAVEN, CONN. • RUSS CHAMBERLIN COMPANY, PORTLAND 14, ORE. J. BOYD COATES, GLENSIDE, PA. • CORBY SUPPLY COMPANY, ST. LOUIS, MO. • FRANK T. DONNELLY COMPANY, PITTSBURGH 38, PA. • HASKEL ENGINEERING & SUPPLY CO., GLENDALE 4, CALIF. • HASKEL ENGINEERING & SUPPLY CO., SAN FRANCISCO 7, CALIF. • AIR-DRAULICS COMPANY, PHOENIX, ARIZ. • INDUSTRIAL AIR & HYDRAULIC EQUIP. CO., DETROIT 15, MICH. LINCOLN SUPPLY COMPANY, PROVIDENCE, R. I. • L. H. MONSEES, INDEPENDENCE, MO. • THE NEFF ENGINEERING CO., FORT WAYNE 3, IND. • POWER DRIVES, INCORPORATED, BUFFALO, N. Y. • SCOTT EQUIPMENT & ENGINEERING CO., DAYTON 10, OHIO • ROBERT TAYLOR & SONS, SALT LAKE CITY 10, UTAH • WYATT SALES COMPANY, CLEVELAND 15, OHIO TRI-STATE SUPPLY COMPANY, BROOKLYN 33, N. Y.

BRIEFS / continued

Future Events

January 14-18, 1957: SAE Annual Meeting and Engineering Display. The Sheraton-Cadillac and Statler Hotels, Detroit, Michigan.

January 28-31: Plant Maintenance and Engineering Show. Public Auditorium, Cleveland, Ohio.

January 30: ASME Philadelphia Chapter, Fluid Power Division. C. B. Frellsen, chief hydraulic engineer, Joy Mfg. Co., "Hydraulics in Mining Machinery".

March 20-22: SAE Production Meeting and Forum, Hotel Statler, Buffalo, N. Y.

March 25-29: 10th Western Metal Congress and Exposition. Congress will be held at Ambassador Hotel, exposition at Pan-Pacific Auditorium, Los Angeles, Calif.

April 2-5: SAE Aeronautic Meeting, Aeronautic Production Forum, and Aircraft Engineering Display, Hotel Commodore, New York, N. Y.

June 9-14: Third Annual Automation Seminar, Pennsylvania State University, University Park, Pa. For complete information and registration contact Chester Linsky, assistant professor of industrial engineering.

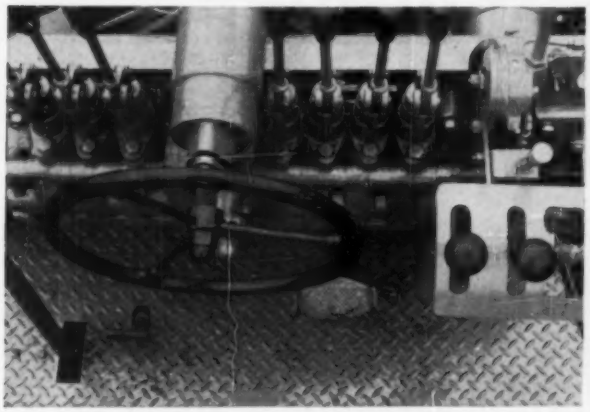
September 9-12: SAE Tractor Meeting and Production Forum, Hotel Schroeder, Milwaukee, Wis.

October 1-5: SAE Aeronautic Meeting, Aircraft Production Forum and Aircraft Engineering Display, The Ambassador, Los Angeles, Calif.

October 17-18: The 13th Annual Conference on Industrial Hydraulics. Hotel Sherman, Chicago, Illinois. Raymond D. Meade is Conference Secretary.

November 4-6: SAE Transportation Meeting, Hotel Statler, Cleveland, Ohio. ▼▼▼

The hydraulic system in this Galion T-600 Road Grader provides fingertip operation of the blade, circle, leaning front wheels and attachments. The large hand-wheel maintains precise control over the combination manual and hydraulic booster steering. Power is delivered through dependable Republic ELECTRUNITE Hydraulic Line Tubing.



Where high pressures power heavy equipment, Galion uses

Republic ELECTRUNITE® Steel Hydraulic Line Tubing

The Galion Iron Works, one of the world's largest producers of road graders, depends on Republic ELECTRUNITE Steel Hydraulic Line Tubing to pipe the power for its heavy-duty equipment. In controls, adjustments and attachments, working pressures range from 300 PSI to 1500 PSI for shock loads.

In Galion equipment, tubing ends are double-flared 180° to provide extra wall thickness and to assure a superior seal at the fitting. Such severe fabrication might crack or split ordinary tubing. But Galion reports excellent results with Republic Hydraulic Line Tubing—thanks to the uniform ductility of the steel and uniformity of wall thickness.

Produced to a highly restrictive specification, resulting from knowledge gained in the manufacture of critical ammunition components, Republic welded tubing will provide unsurpassed performance in all high-pressure applications.

This proved dependability is due in part to highly specialized techniques of manufacture, developed in years of research and experience. Because the tube is formed from flat rolled steel, the resulting uniform wall coupled with high ductility provides excellent bending and flaring characteristics. And the tube is not subject to longitudinal and transverse cracks.

Get the facts on how Republic ELECTRUNITE Hydraulic Line Tubing can substantially reduce maintenance costs in complicated installations. It's available in a wide range of sizes and in wall thicknesses regularly used in hydraulic applications. Fits all standard fittings and accessories. Send coupon for additional information.

REPUBLIC STEEL

World's Widest Range of Standard Steels and Steel Products

REPUBLIC STEEL CORPORATION
Steel and Tubes Division
Dept. C-2855
211 East 131st Street
Cleveland 8, Ohio

I would like a sales representative to call with additional information on ELECTRUNITE Hydraulic Line Tubing.

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

BUILT ON THE SAME RUGGED PRINCIPLE AS OTHER WORLD-FAMOUS SCHRADER PRODUCTS . . .

Especially useful where space is limited. Engineered for long, hard use on all types of hydraulic machines. The Standard Gauges are industry's favorites.

Schrader Hydraulic Gauges

retain accuracy under SHOCK and OVERLOAD

Many thousands of these famous Schrader hydraulic gauges have given long years of dependable "work-horse" service in countless plants of every description

Schrader's full line of hydraulic gauges operate on direct action, using the spring-loaded principle. All replaceable parts are interchangeable. Maintenance and replacement of parts require no special tools or skilled labor. Do it in your own shop. No need for recalibration. **All are available in nine standard pressure ranges up to 5000 psi.**

SHOCKPROOF
HYDRODIAL PRESSURE GAUGES

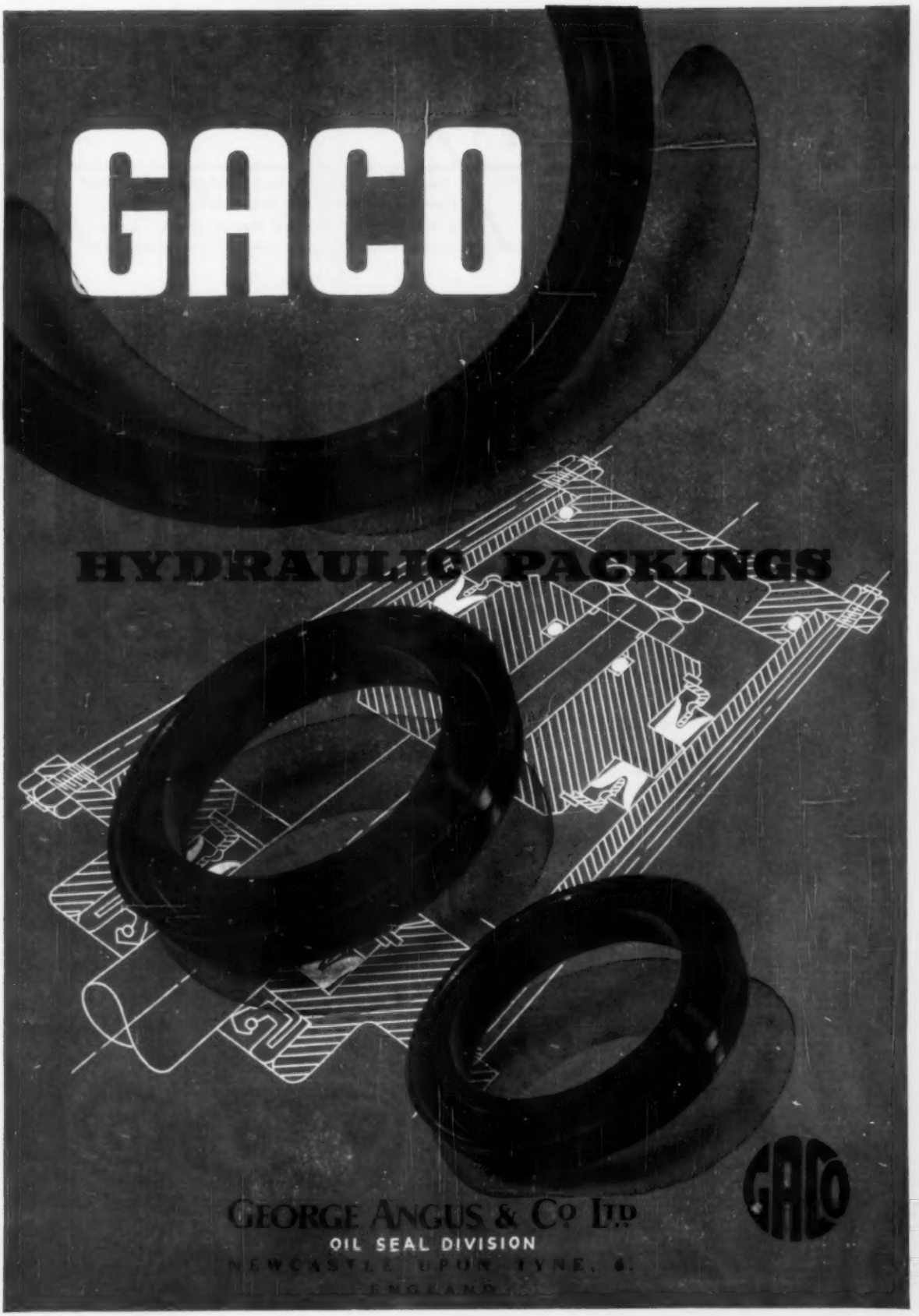
This completely enclosed unit has a durable plastic face with large, easy-to-read numerals that can be read from 50 feet. Snubber is built-in. Easy to install and maintain.

Order Schrader products by name from your supplier.
Get the best in couplers, fittings, ferrules, clamps.

A. SCHRADER'S SON
Division of Scovill Manufacturing Company, Incorporated
456 Vanderbilt Avenue, Brooklyn 38, N. Y.

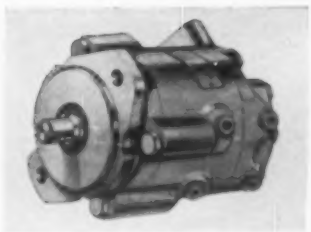
Schrader®
ESTABLISHED IN 1844

FIRST NAME IN THE USE OF AIR
FOR INDUSTRIAL PRODUCTION AND CONTROL


GACO
HYDRAULIC PACKINGS
GEORGE ANGUS & Co LTD
OIL SEAL DIVISION
NEWCASTLE UPON TYNE, 6.
ENGLAND
GACO

New Products

Components, tools and equipment for fluid power systems. For more information fill in and mail post card bound in this issue.



PISTON PUMP
. . . has rugged design

Designation: Series PF-3006

Features: Designed for construction machinery, materials handling devices, aircraft and agricultural equipment, test stands and presses. Rated at 2,000 psi, with 3,000 psi maximum intermittent pressure, this pump permits reduction in sizes of lines, fittings, valves and cylinders. Fitting adapters are available with SAE straight threads or pipe threads. Shaft rotation can be in either direction and unit can be mounted in any position.

Specifications: Displacement per revolution is .597 cu. in. with 2600 rpm and 8.6 hp. Unit will handle 2.8 gpm at 1200 rpm and 4.15 gpm and 1800 rpm.

Dynex, Inc.
Milwaukee, Wis.

Circle 130 on Reader Service Card

SOLENOID VALVE
. . . has 4 independent controls

Designation: Type HV

Features: Valve mounts on piping running at any angle. Primarily designed for filling operations, hydraulic systems and elevators, it can be used in various general service applications. Four independent controls, flow, closing speed and opening speed adjustments and manual opening stem, are grouped in a cluster for convenience. Flow adjustment increases or decreases flow through valve. Closing and opening adjustments are made independently and positively. Neither adjustment has any effect on the other. Manual opening stem allows operation of valve in case of power failure or emergency. Other features include packless design, unbreakable piston rings, full ports, non-shock closing and coils unconditionally guaranteed for one year.

J. D. Gould Company
Indianapolis, Ind.

Circle 131 on Reader Service Card

POWER UNIT
. . . with PV Pump

Designation: ST-10

Features: Basic unit has capacity of 5 gpm at 2000 psi and comprises a JIC 10-gallon reservoir, 3 hp electric motor, pressure compensated variable displacement pump and relief valve. Under light load, pump automatically reduces oil volume pumped, yet maintains full required circuit pressure. Variable volume control is available for maximum volume settings, reducing waste of power. Two circuits are available for adapting the unit to feed and traverse jobs. Each circuit contains all required hydraulic components. Complete electrical control systems containing all necessary electrical components, and wired to suit, may also be had.

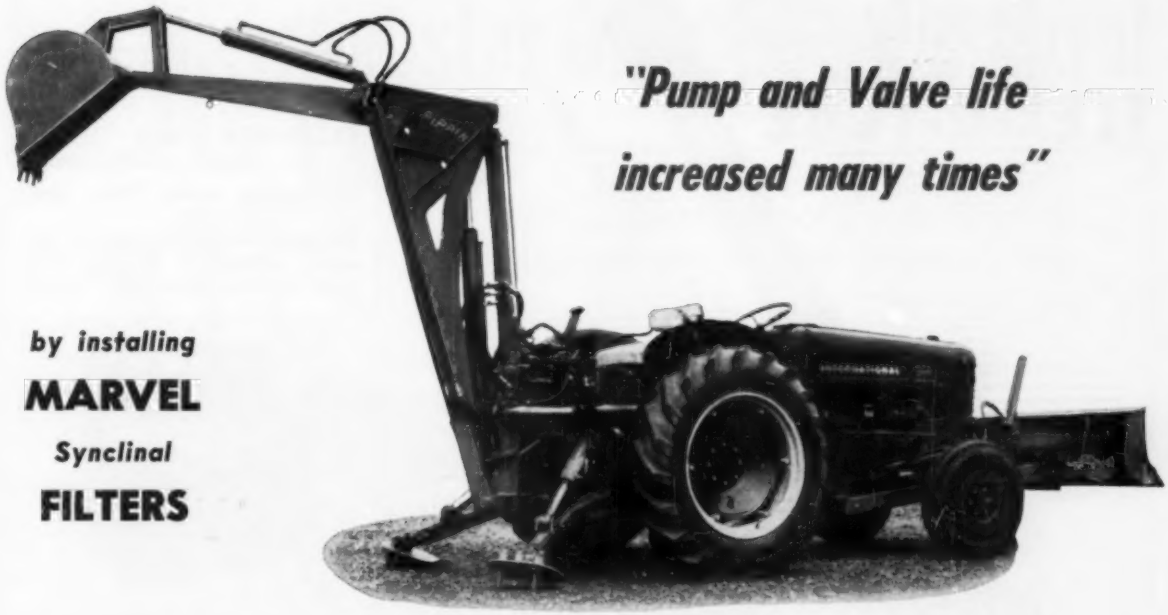
The Rosaen Company
Hazel Park, Mich.

Circle 132 on Reader Service Card

Continued on page 44

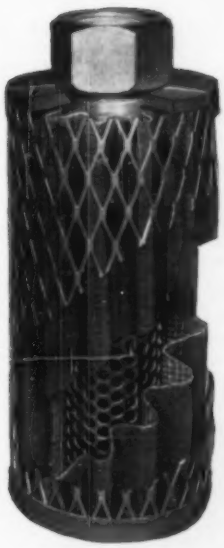
"Pump and Valve life increased many times"

by installing **MARVEL** *Synclinal* **FILTERS**



PIPPIN Excavator and PIPPIN Angling Bulldozer

Pippin Construction Equipment, Inc. (Manufacturers) White River Junction, Vt. advise that—"Originally the PIPPIN Excavator was not equipped with a filter. Due to this, excessive pump, valve and cylinder wear was experienced. Since installing the Marvel Synclinal Filter, pump and valve life has been increased many times. Of utmost importance is the fact that customers are better satisfied and maintenance has been reduced to a minimum."



SUMP TYPE (Cutaway)

OVER 700 other Original Equipment Manufacturers are installing MARVEL SYNCLINAL FILTERS as Standard Equipment!

For Dependable Protection on Your Hydraulic and other Low Pressure Systems—investigate MARVEL SYNCLINAL FILTERS

Balanced, Synclinal design is the answer to the growing preference for Marvel Filters to assure maximum protection of equipment—and maintaining the greatest degree of cleanliness of hydraulic oils, fire-resistant hydraulic fluids, coolants, lubricants and water.

THEY MEET J. I. C. STANDARDS

EASY TO CLEAN

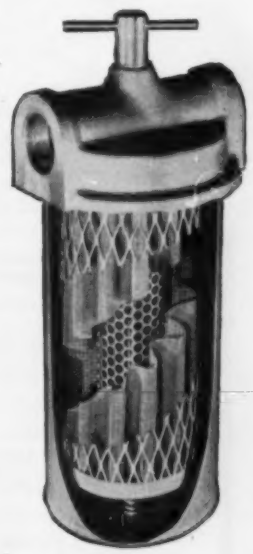
Another outstanding feature of Marvel Synclinal Filters is the fact that they can easily be disassembled, thoroughly cleaned and reassembled in a matter of minutes. Thus—"down time" for filter maintenance is reduced to the absolute minimum. Line type operates in any position and may be serviced without disturbing pipe connections.

A SIZE FOR EVERY NEED
Easy To Install

Marvel Synclinal Filters are easy to install in sump or on line preceding pump. Both sump type and line type models are available in capacities from 5 to 100 G. P. M. Monel mesh sizes range from coarse 30 to fine 200.

IMMEDIATE DELIVERY

Our catalogs contain complete engineering data and dimensional charts of all models and sizes. You can order a filter to meet your specific requirements and get IMMEDIATE DELIVERY.



LINE TYPE (Cutaway)

Catalogs containing complete data available on request

MARVEL ENGINEERING COMPANY

7227 N. Hamlin Ave., Chicago 45, Ill. **PHONE: Juniper 8-6023**

Without obligation, please send me complete data on Marvel Synclinal Filters, as indicated: (AH-12)

- ☐ Catalog #107—For Hydraulic Oils, Coolants, Lubricants.
- ☐ Catalog #200—For Fire-resistant Hydraulic Fluids (Aqueous Base)
- ☐ Catalog #400—For Fire-resistant Hydraulic Fluids (Synthetic)
- ☐ Catalog #301—For Water

Name ..... Title .....

Company .....

Address .....

City ..... State .....

Specify FLEX-O-TUBE

TEFLON* Hose Assemblies

Engineered for easy, efficient engine and airframe installation and manufactured for dependable performance, Flex-O-Tube Teflon hose assemblies are ideal for many other severe operating conditions.

Every assembly combines the exclusive properties of Teflon with the strength of stainless steel wire braid reinforcement and the trouble-free performance of factory crimped-on fittings. And every Flex-O-Tube Teflon hose assembly gives you these important features:

- Handles synthetic oils, fuels, nitric acid and propellants from −100°F to +500°F.
- Makes lighter, thinner, more compact aircraft plumbing with practically unlimited operating life.
- Safe up to 1,500 psi working pressure, depending upon size.
- Preformed lines save space and weight, increase flexibility and are easily installed.
- Stainless steel, steel and aluminum crimped-on fittings are leakfree and blowoff proof.
- Unlimited storage life.

Flex-O-Tube Teflon hose assemblies are also the answer for industrial uses where lines are subjected to chemical attack or high temperatures and for use where clean, non-fouling inner walls are required, as in handling foods, beverages and drugs. For the solution to *your* hose problem, send details or prints to our Engineering Department. You'll receive recommendations and quotations from Flex-O-Tube . . . hose coupling specialists for more than 25 years.

HOSE, HOSE ASSEMBLIES AND FITTINGS FOR EVERY AIRCRAFT, AUTOMOTIVE AND INDUSTRIAL REQUIREMENT

*DUPONT TRADEMARK — LICENSED FOR MANUFACTURE BY RESISTOFLEX CORP.

Division of MERIDAN CORP.

FLEX-O-TUBE
REGISTERED TRADE MARK

2527 JIM DALY ROAD • INKSTER, MICHIGAN

(BRANCH) 10711 CHANDLER BLVD., NORTH HOLLYWOOD, CALIFORNIA
(CANADA) FLEX-O-TUBE COMPANY., LTD., WINDSOR, ONTARIO, CANADA
DISTRIBUTORS IN PRINCIPAL CITIES

New Products continued

VALVE TEST STAND
. . . checks safety valves

Designation: Safety Valve Test Stand
Features: Unit can be used for the regular setting and checking of all types of safety valves from ¼-inch

screwed to 4-inch flanged. Model illustrated gives accurate readings for pressures between zero and 1000 pounds. Bulletin No. 545 gives description and specifications.

Industrial Engineering Corporation
Louisville, Kentucky

Circle 133 on Reader Service Card

VALVE AMPLIFIER
. . . uses transistors

Designation: Transistorized Electro Hydraulic Valve Amplifier.
Specifications: Unit delivers 8 ma differential current to 2000 ohm center-tapped load. 60 d.b. power

gain. No reduction in performance to 170 degrees F. For use with either 60 cycle or 400 cycle excitation. Envelope of 1" x 2" x 3" includes variable gain, balance and quiescent controls.

Control Specialists, Inc.
Inglewood, California

Circle 134 on Reader Service Card

For more NEW PRODUCT reviews turn to page 113

NEW...Webster Directional Control Valves

ECONOMICALLY PRICED SINGLE SPOOL AND MULTI-SECTIONAL VALVES

These new WEBSTER single spool units and multi-sectional (series type) Directional Control Valves are designed to control and direct the flow of oil to cylinders and hydraulic motors in agricultural machinery, road-building equipment, machine tools, and a variety of other applications. They combine a very economical price with outstanding performance features including:

- **Built-in relief valves with *poppets of molded nylon* for minimum leakage . . . convenient screw adjustment**
- **Valve spool hard chrome plated and ground after plating for low internal leakage and long life**
- **May be furnished with detent pressure return feature which automatically shifts valve spools from "ON" to Neutral when cylinder being operated reaches end of stroke, or exceeds preset pressure**
- **Variety of mounting brackets, tapped mounting holes, to accommodate almost any mounting situation**
- **Inlet port provided on single spool valves on either right or left side of valve body**
- **Control handles on single spool valves can be installed in any of four positions, 90° apart**
- **Choice of spools for 4-way or 3-way operation, open or closed center**

These valves are designed for operating pressures up to 2000 psi, shock pressures to 5000 psi. They have a capacity of up to 20 gpm with a minimum of back pressure. All ports have ¾" pipe thread. Available with relief valves, normally set at 1000 psi which can be adjusted from 500 psi to 1500 psi. Single spool unit valves can be connected in series to operate two or more cylinders, independently or together. Multi-sectional valves are available up to six spools.

Write Today for Complete Information

Please forward complete information, including dimensional drawings and back pressure curves on

- ☐ Single spool unit valve
- ☐ Multi-sectional (series type valve)
- ☐ Please send catalog on hydraulic pumps and motors (up to 30 gpm)

Name_____

Title_____

Company_____

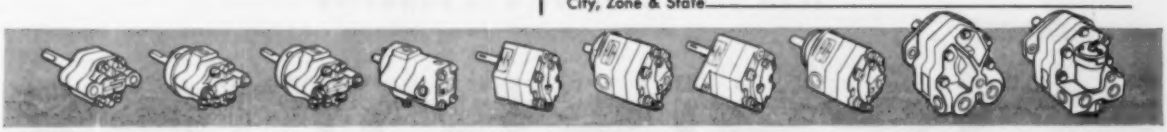
Street_____

City, Zone & State_____

OIL HYDRAULICS DIVISION

WEBSTER ELECTRIC

RACINE • WISCONSIN



MANUFACTURERS OF A COMPLETE LINE OF OIL HYDRAULIC PUMPS FROM 1/5 TO 30 GPM CAPACITY

HOSE PROBLEMS?

You need this TEFLON® hose

SOLVE your really tough jobs for flexible hose with *Fluoroflex®-T hose assemblies* – the original Teflon hose now proved by over 4 years of demanding service.

With tube made from a patented, special compound of Teflon, the hose is completely inert to the most corrosive chemicals, active oils and fuels, gases, all hydraulic fluids. No swelling, erosion or restriction of tube.

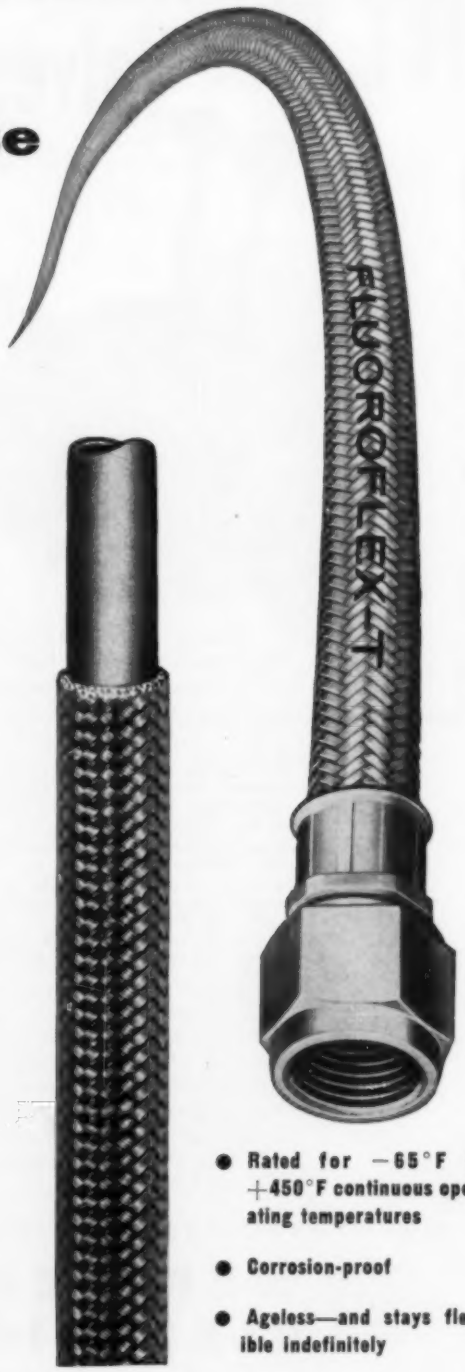
SAE 304 stainless steel braid reinforces for 1000 psi service (higher in some cases) and maintains this strength by its corrosion resistance.

Permanent, swaged fittings give positive protection against leakage and blowoff.

These lightweight, space-saving hose assemblies solve tough problems, increase reliability, cut replacement costs. Made by the originator of Teflon hose – the one company that makes its own Teflon tubing as well as hose assemblies. For more data, write RESISTOFLEX CORPORATION, Roseland, N. J.; Western Plant: Burbank, Calif.

® Teflon is a DuPont trade mark. Fluoroflex is a Resistoflex trade mark.

OVER 2 YEARS' TROUBLE-FREE OPERATION: With this airless spray equipment, industrial finishes and strong solvents are sprayed hot, at 500 to 1000 psi. Fluoroflex-T hose has set a service record of over 2 years with no failures.



- **Rated for −65°F to +450°F continuous operating temperatures**
- **Corrosion-proof**
- **Ageless—and stays flexible indefinitely**

20th year of service to industry

Resistoflex

Circle 89 on Reader Service Card

Because these solenoid covers are essential to valve operation, they are chained to the valves. Also, they fasten with 4 "captive" screws that cannot be mislaid. A manual operating button makes it possible to operate the valve without removing its cover.

Now! solenoid-controlled air valves that defy improper maintenance ...they won't operate with their covers off!

When a solenoid valve operates without its cover, trouble is not far off. Dirt, oil, cutting fluid, chips are sure sooner or later to jam the solenoid, and the valve will fail to shift.

That can't happen with these new Hannifin valves!

The solenoids are held in place by their covers and won't operate the valves unless the dust-tight, splashproof covers are firmly tightened.

These new valves, which conform to the latest J.I.C. recommendations, are part of the complete "P-M" Pilot-Master line. New heads with these new solenoid covers are offered on 2-way, 3-way and 4-way Pilot-Master Valves (air-operated). The smaller, direct-operated 3-way and 4-way valves in the "P-M" line have been redesigned to use the same new covers. This added feature is just another reason why it pays to standardize on Hannifin air control valves.

AIR CONTROL

HANNIFIN

VALVES

Complete information **on all Hannifin Air Control Valves is in this catalog. It belongs in your files. Write for your copy. Hannifin Corporation, 545 S. Wolf Road, Des Plaines, Illinois.**

Useful Literature

For your free copy of publications reviewed, fill in the reader service card

HYDRAULIC ENGINEERING SERVICES . . . offered by Cardwell Machine Company, are discussed in their "Hydraulic Engineering for Industry" Bulletin. Both standard and special applications are illustrated. JIC standards are maintained in design and construction and all fabrication is done at one place. Complete engineering and design services are available through a network of sales and service engineers, and a large inventory is maintained.

Circle 180 on Reader Service Card

AIR HOSE . . . flexible, lightweight, kinkless, for service up to 300 psi is produced by Raybestos-Manhattan, Inc. Condensed catalog 25C gives description and specifications on the various types of hose and recommended useage. Other industrial rubber products are also covered.

Circle 181 on Reader Service Card

PISTON PUMPS . . . for high pressure service are covered in Bulletin DG-1 released by Blackhawk Mfg. Co. Specifications and illustrations cover several types for pressures to 6000 psi. Units feature low-cost due to large production. Engineering Bulletin 1-P, covering twin-piston type for general service at 100 to 4000 psi, is also available.

Circle 182 on Reader Service Card

SOLENOID VALVES . . . produced by Skinner Electric Valve Division, The Skinner Chuck Company are described in Catalog No. D2. Specifications are given for the line of 2, 3 and 4-way valves for air and hydraulic service, including the new miniature cut-off valve. Valves feature fast action, durability and compactness. Internal parts are of stainless steel and brass. They will operate in any position and models are available for service up to 1000 psi, at ambient temperatures from −65 degrees to +180 degrees F.

Circle 183 on Reader Service Card

PNEUMATIC INSTRUMENTS . . . for process control are manufactured by United States Gauge Division of American Machine and Metals, Inc. Catalog 505, in 16-pages, discusses indicating pilots, transmitters and receiver gauges. Shown for the first time is the 3½ inch scanning diaphragm receiving gauge with rotatable dial, permitting operator to rotate dial to common set point. Complete information is given on measuring elements for pressure and temperature applications.

Circle 184 on Reader Service Card

SERVO VALVE . . . model SA-17D is covered in Technical Bulletin No. 6 released by Sanders Associates, Inc. This is a miniature size, electro hydraulic valve using modified two stage hydraulic amplifier with internal force feedback to develop large hydraulic output flows with relatively low input power requirements. Maximum force motor current is variable from ±5 ma to ±200 ma and coil resistance from 0-1 gpm to 0-6 gpm at 1000 psi drop. Bulletin includes diagram of the valve and graphs showing frequency response and force motor characteristics.

Circle 185 on Reader Service Card

TUBE FITTINGS . . . for heavy duty service, are manufactured by The Imperial Brass Mfg. Co. Fittings stand up under vibration and severe service and can be disconnected and reconnected repeatedly. Assembly is simple, with no loose sleeve or tube flaring required. Working pressures up to 5000 psi. Bulletin 3002-A gives details and specifications along with illustrations of applications.

Circle 186 on Reader Service Card

FILTRATION . . . Bowser Inc. and its associated companies have published a 16 page giant size equipment digest which describes their extensive line of industrial equipment. Of interest to the designer and user of hydraulic equipment is the information on filter units.

Circle 187 on Reader Service Card

PISTON & SEALING RINGS . . . manufactured by Koppers Company, Inc. are described in their 23-page bulletin. Various types of compression, oil control, and sealing rings available are described. Bulletin also includes information on ordering and fitting of piston rings, special sealing ring applications and description of materials used in manufacturing.

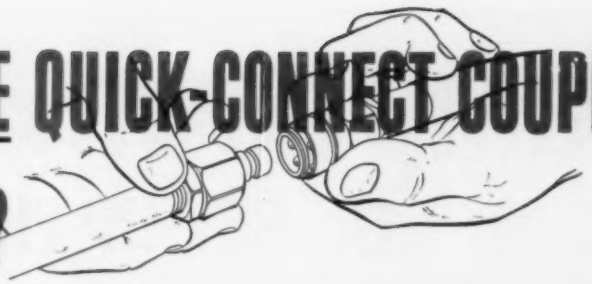
Circle 188 on Reader Service Card

HYDRAULIC EQUIPMENT . . . of all types is built to JIC standards by Century Hydraulics, Inc. Catalog is available covering some of their standard items including reservoirs, oil level sight gauges, breather caps and other accessories.

Circle 189 on Reader Service Card

For more reviews of FREE LITERATURE turn to page 122

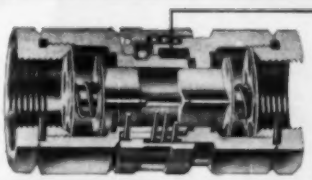
WHICH SNAP-TITE QUICK-CONNECT COUPLING IS BEST FOR YOU?



SNAP-TITE "H" COUPLING . . . . . FOR HIGH PRESSURE APPLICATIONS

FOR HYDRAULIC OR AIR

"H" Coupling for high strength, higher efficiency, high-resistance to heavy line surge. Sizes: ⅛" thru 12". Bulletin No. 240

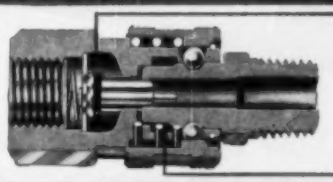


Exclusive U-packer gives a positive seal without compression set because of rubber distortion. Line pressure inside the U-packer keeps it open and forced against its metal backing—the higher the pressure, the tighter the seal.

SNAP-TITE HI-FLOW COUPLING . . . FOR LOW PRESSURE APPLICATIONS

FOR AIR AND FLUIDS UP TO 150 p.s.i.

Hi-Flow is recommended to connect small air tools to plant air system, and for low pressure fluid transfer in small lines. Sizes: ⅛" thru ¾". Bulletin No. 230

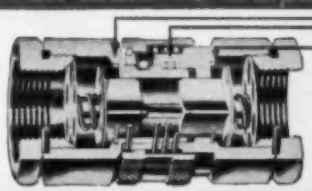


Bonded valve washer
(pat. pending on valve construction)

Exclusive U-packer

SNAP-TITE "HK" COUPLING . . . . . FOR HARD TO HANDLE FLUIDS

FOR FUMING ACIDS, ALKALIES, SOLVENTS, AND HIGH PRESSURE STEAM . . . "HK" is the only coupling now on the market for fluid temperatures from —100° F to +500° F . . . and for live steam up to 460° F. Its seals are made of Teflon for which there is no known solvent. Sizes: ½" thru 3". Bulletin No. 270



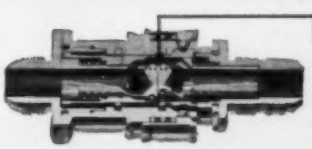
Teflon Valve Seal

Teflon Nipple Seal

Teflon Valve Seal

SNAP-TITE NO-SPILL COUPLING . . . FOR MINIMUM AIR INCLUSION

FOR AIRCRAFT, MISSILE HYDRAULIC, FUEL SYSTEMS which cannot stand air in the lines, and for transmitting fluids which *must not spill*, the Snap-Tite no-spill coupling is recommended. Bulletin No. 280

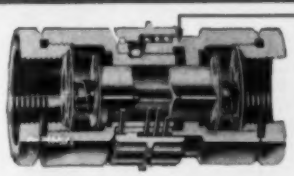


Flush valves prevent spillage, air inclusion. Snap-Tite will engineer special variations to your requirements.

SNAP-TITE "E" COUPLING . . . . . FOR VACUUM and VERY LOW PRESSURE

FOR VACUUM SYSTEMS IN THE MICRON RANGE

"E" Coupling performs in the *micron* range in the smaller sizes both connected and disconnected. Recommended, too, for gravity flow . . . U.L. approved for LP Gas. Sizes: ⅛" thru 12". Bulletin No. 250



Nipple seals in coupler by depressing the lip of the E packer and slightly compressing the body of the packer. This new E-packer gives positive seal under high-pressure, low-pressure, and vacuum.

Snap-Tite Couplings are available plain, (without valves), and with either single or double shut-off. Couplings normally furnished in alloy steel, but all (except hi-flow) are also available in brass, aluminum, or stainless steel with a variety of finishes.

SNAP-TITE, INC., UNION CITY 1, PA.

Snap-Tite

SNAP-TITE COUPLINGS CAN HANDLE ALMOST ANYTHING THAT FLOWS

Clamp down *quick* ON SET-UP TIME AND COSTS !

NEWTON TRADE PRODUCT MARK
CLAMP
Hydraulic MULTIPOINT

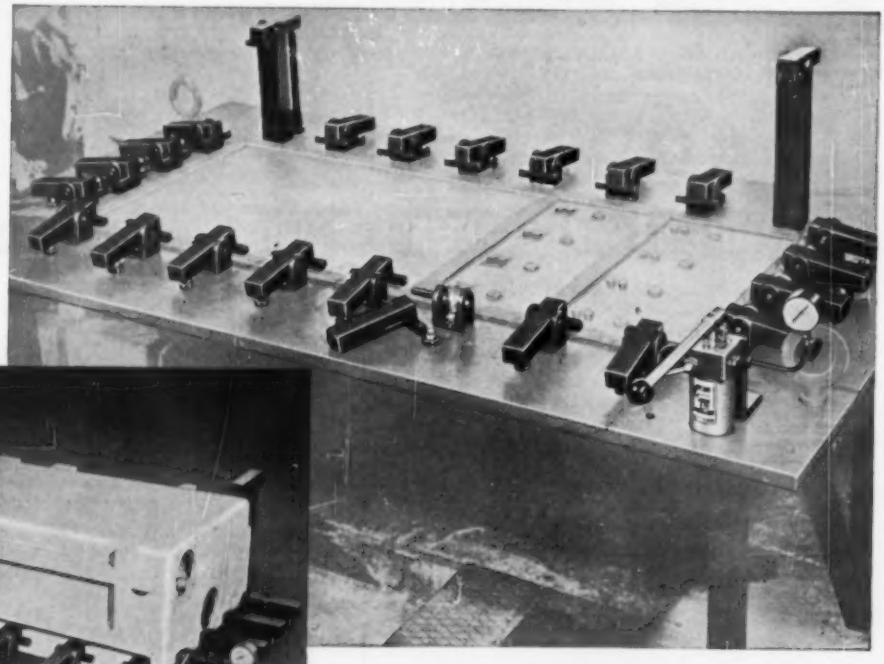
Lightning 'ON-OFF' Clamping and Release

Equal pressure at all points

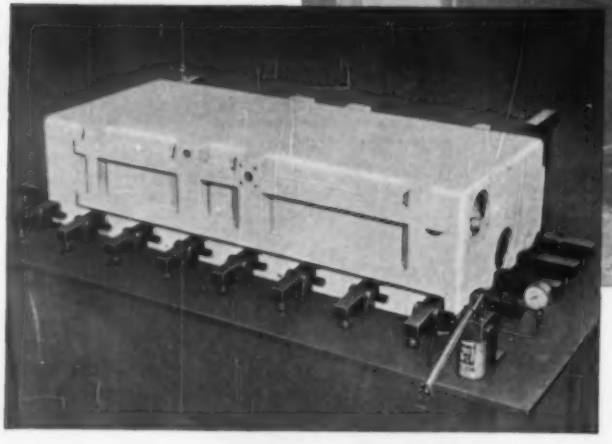
Inexpensive – quickly repays cost

Clamps can be used again and again on different applications.

Here's how DAVEY PAXMAN & CO. LTD. Colchester, use NEWTON CLAMPS in a 24 Point Set up . . .



Sump Pressure Test Rig.



Send for Publication No. F/243.

POWER JACKS LIMITED

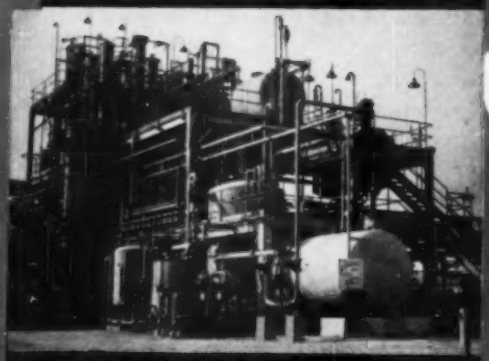
Valetta Rd. • Acton • London W.3 • England • Telegrams: Newsorber Ealux London

Circle 83 on Reader Service Card

DROP FORGED STEEL

valves, fittings and flanges by Vogt

REFINERIES



CHEMICAL PLANTS

POWER PLANTS

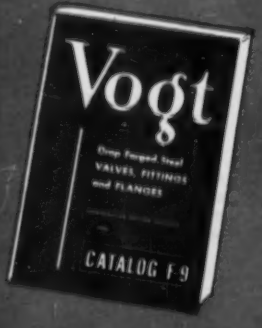
USED and TRUSTED by the NATIONS KEY INDUSTRIES

There are good reasons behind the trust which America's key industries have placed in Vogt valves, fittings, and flanges for half a century. They know that *drop forged materials* are uniform in structure, fine grained, and free from porosity. They know, too, and appreciate the meticulous care given these products through every stage of forging and machining in Vogt's modern shops, and about the many rigid tests and inspections. And that is why these products enjoy such an impressive record of performance in withstanding the shocks and stresses imposed by high or low pressures and temperatures and in resistance to erosive and corrosive conditions.

Service is another important factor in this confidence because Vogt maintains the world's largest and most complete stock of drop forged steel valves, fittings, and flanges always ready for immediate shipment.

Write for Catalog F-9. Consult its 400 pages for the complete Vogt line of drop forged steel valves, fittings, and flanges for oil, steam, water, air, gas, and refrigeration services.

Address Dept. 24A FAH



HENRY VOGT MACHINE CO., LOUISVILLE, KY.

BRANCH OFFICES: New York, Philadelphia, Chicago, Cleveland, St. Louis, Dallas, Charleston, W. Va., San Francisco

HENRY VOGT MACHINE CO. 75th Anniversary LOUISVILLE, KY.

Circle 113 on Reader Service Card

FLUID POWER *Pioneers*

B. I. ULINSKI

Automatic Transportation Co.
Chicago, Illinois

● Fluid Power Pioneers . . . are selected by the editors of APPLIED HYDRAULICS to acknowledge outstanding contributions they have made in the use of fluid power to improve their company's products.

"LIGHTEN life's loads" is a slogan at Automatic Transportation. Since joining Automatic in 1921, "Brownie" Ulinski's work with material handling equipment has been aimed toward carrying out that slogan.

His record of achievement is substantial. Since 1932, when he was appointed Chief Engineer, he has obtained or has pending more than 50 patents. Many of these patents include developments in hydraulic devices and fluid power applications to industrial trucks. In 1946, he pioneered the use of high pressure hydraulics (around 3000 psi) in industrial fork lift trucks. The use of the higher pressure permits use of smaller lift rams, which with the smaller reservoirs, pumps and piping, results in a much more compact truck.

Brownie was instrumental in developing a line of control valves which permit control of the load lifting and tilting motions either simultaneously or independently by means of a single control handle in spite of the fact that pressure requirements for the two movements may vary immensely.

Full hydraulic control of a lift truck has also been one of Brownie Ulinski's projects. Under his direction a special purpose machine was developed where power to the lift, the steering mechanism and all drive wheels was by means of hydraulics. The special control valves were remotely controlled from the operator's platform which was placed on the lift carriage.

Pioneer work resulted in Automatic being the first to develop powerful hydraulic steering mechanisms for use with giant multi-wheel trucks capable of handling 100,000 pounds or more.

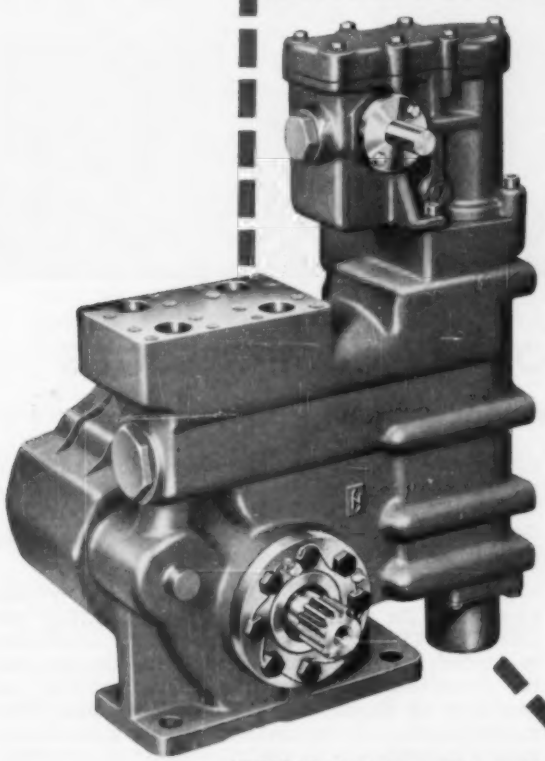
During his 35 years at Automatic, Brownie has actively participated in engineering societies. He is also a member of the Executive Committee of the National Conference on Industrial Hydraulics.

Ulinski, who was named Director of Engineering in 1951, recently was appointed Director of Product Research. About his new job, he says: "The fork lift truck is a very fertile field. With my new assignment, I will be able to spend more time on creative projects. I love this kind of work". ▼▼▼

CUSTOM DESIGNED
FLUID POWER SYSTEMS
Start with HYDRECO®

THE PROBLEM • • •

To provide a hydraulic system for complete control of a large bulldozer affording sensitive and positive operation of the blade. The system must be extremely rugged, of minimum weight, capable of handling upwards of 160 hp and compacted into definite space limitations.



HYDRECO Fluid Power Unit combination for International Model TD-24 Bulldozer. Rated 160 gpm at 1600 rpm — 1475 psi.

THE SOLUTION • • •

HYDRECO engineers, drawing upon years of experience in solving Mobile Equipment problems, CUSTOM DESIGNED the unit shown at the left. Here, in a single assembly incorporating Pump, Control and Auxiliary Valves, HYDRECO engineers effect an answer which precisely meets all of the requirements for the International Harvester TD-24 Dozer . . . RUGGEDNESS . . . COMPACTNESS . . . WEIGHT ECONOMY . . . PERFORMANCE AND PRICE.

The ability to CUSTOM DESIGN for the specific need can be a highly advantageous facility for YOU. CUSTOM DESIGNING serves to complement the complete line of HYDRECO Fluid Power Pumps, Motors, Valves and Cylinders which are "standard" for so many famous names in Mobile Equipment.

Write for Bulletin No. 400 describing new developments in HYDRECO FLUID POWER. Your inquiry on specific design problems is a challenge the HYDRECO engineer likes to see.

Member NFPA

NFPA NATIONAL FLUID POWER ASSOCIATION

KALAMAZOO DIVISION
THE NEW YORK AIR BRAKE COMPANY

9004 E. MICHIGAN • KALAMAZOO • MICH.

INTERNATIONAL SALES OFFICE, 90 WEST ST., NEW YORK 6, N. Y.

Write—

KALAMAZOO Division
The New York Air Brake Company
9004-12 E. Michigan
Kalamazoo, Michigan

Gentlemen:
Please furnish the following:

- ☐ Copy of Bulletin No. 400.
- ☐ Further information on HYDRECO CUSTOM DESIGNING.

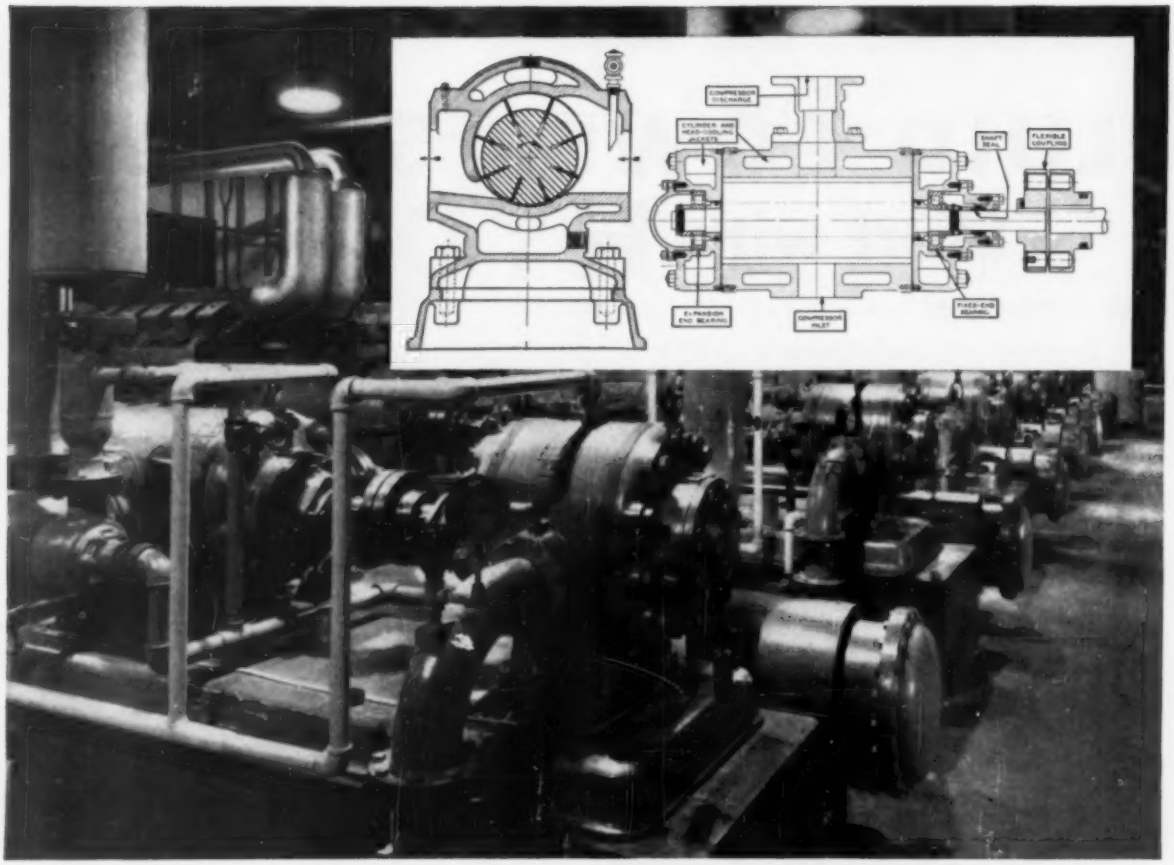
Name _____

Company _____

Address _____

City _____ Zone ____ State _____

Circle 74 on Reader Service Card



HERE ARE 7 FULLER ROTARY COMPRESSORS

. . . in *any* quantity they are an investment in dependability

The wide and continuing acceptance of the Fuller Rotary Compressor in industry is based on a number of unique design features, eminently suited for day in and day out operation in any rugged situation. Indoors or out, its trouble-free operation makes for minimum maintenance and operating costs.

There are 8 good reasons why the Fuller Rotary Compressor enjoys such widespread use—they may easily serve as reasons why your next compressors should be Fuller Rotaries.

1. SIMPLICITY—Elimination of compressor valves, crankshafts, pistons and other moving parts greatly reduces the need for attention, adjustment and replacement. 2. PULSATION-FREE FLOW—Rotary compression eliminates pressure fluctuations and simplifies metering problems. 3. SUSTAINED PERFORMANCE—Blades are held out by centrifugal force, automatically compensating for wear, thus maintaining new-machine efficiency and capacity. 4. NON-VIBRATING—Rotary principle permits a design completely free of reciprocating parts, avoiding basic cause of vibration.

5. COMPACTNESS—Large capacity in relation to size results in lighter weight. 6. EASE OF INSTALLATION—In smaller sizes, no foundation is needed. Larger units need only concrete slab for foundation. Automatic safety controls are incorporated in package. 7. ECONOMY—Few moving parts of the compressor, and their accessibility, reduce maintenance to the minimum. 8. VERSATILITY—Unit can be operated at various conditions. Capacity variation of 50% can be obtained by change of speed with engine, turbine, or two-speed motor drives.

We'd like to send you fully-descriptive Fuller Compressor literature. It's yours for the asking.

FULLER COMPANY, 142 Bridge St., Catasauqua, Penna.

SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORPORATION

Chicago • San Francisco • Los Angeles • Seattle • Kansas City • Birmingham

C-304
3652

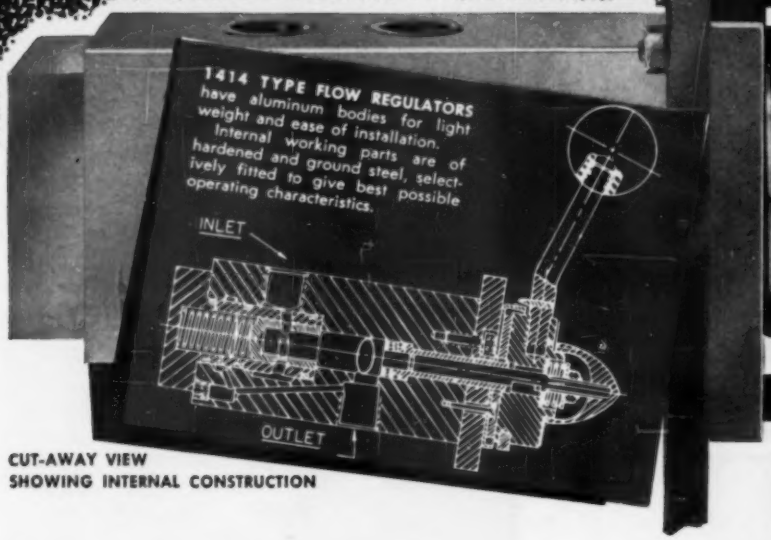
PIONEERS OF HIGH-EFFICIENCY VANE TYPE ROTARY COMPRESSORS SINCE 1930

Circle 39 on Reader Service Card

ADJUSTABLE FLOW REGULATOR

Designed for Panel Mounting

LOOK TO WATERMAN FOR THE ANSWER TO YOUR FLOW CONTROL REQUIREMENTS


1414 TYPE FLOW REGULATORS have aluminum bodies for light weight and ease of installation. Internal working parts are of hardened and ground steel, selectively fitted to give best possible operating characteristics.
INLET
OUTLET

CUT-AWAY VIEW
SHOWING INTERNAL CONSTRUCTION

Waterman Engineering Company have combined in this new Adjustable Flow Regulator all the best, improved features . . . at the same time adapting it to Panel Mounting.

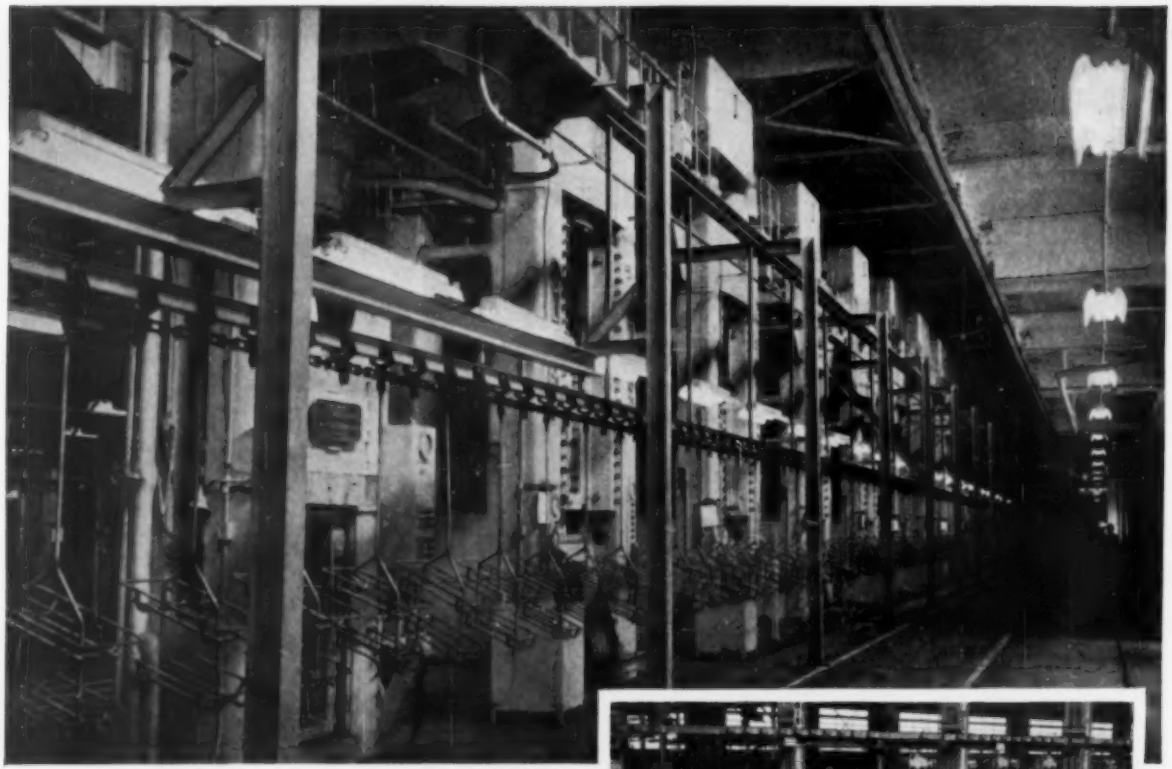
Increases the flexibility of your hydraulic systems . . . ideal for installations requiring frequent changes in operating speeds.

Affords a variable adjustment of flow rate over a wide operating range.

Write for illustrated bulletin A describing the many features of this Adjustable Flow Regulator such as right or left rotation of control handle, 180° handle rotation, pressure drop, regulated flow tolerance, etc.

WATERMAN
ENGINEERING COMPANY
725 CUSTER AVENUE EVANSTON, ILLINOIS.

Circle 114 on Reader Service Card



Youngstown Kitchens Division of American-Standard, developers of the Koldflo process for cold-shaping steel, operates presses ranging in size from 500 to 2,000 tons at the Pittsburgh plant. The plant also includes an exceptionally large concentration of hydraulically-operated Heller cut-off saws. *Texaco Regal Oil R&O* is the exclusive hydraulic medium for all this equipment.

No rust, no sludge no foam in these presses

The Youngstown Kitchens Division of American-Standard operates a large number of Bliss and HPM cold-shaping presses, with a total hydraulic oil capacity of 65,000 gallons, at the Naval Industrial Reserve Ordnance plant that it operates in Pittsburgh, Pa. The oil used exclusively in these presses is *Texaco Regal Oil R&O*.

Youngstown Kitchens chose this great oil for two reasons. First, it had proved outstanding in similar service at the firm's plant in Warren, Ohio. Secondly, exacting run-in tests made in co-operation with the press manufacturers proved that *Texaco Regal Oil R&O* kept systems exceptionally clean — free from sludge, rust and foam. Now, under actual operating conditions, these same benefits continue to assure dependable, trouble-free hydraulic performance.

Improve *your* hydraulic efficiency with *Texaco Regal Oil R&O*. Tests prove it has *more than ten times the oxidation resistance* of ordinary turbine-quality oils — your best assurance of cleaner, smoother-working systems. And there is a complete line of *Texaco Regal Oils R&O* to meet every hydraulic requirement.

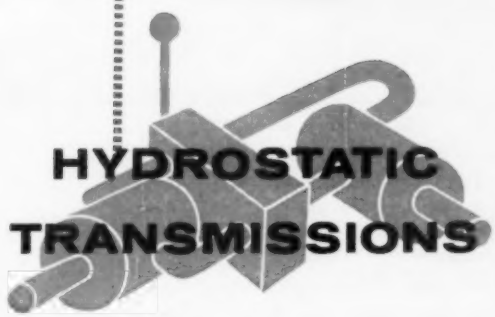
Let a Texaco Lubrication Engineer help you select the proper ones. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, New York.

TEXACO

TEXACO Regal Oils R&O

FOR ALL HYDRAULIC UNITS

Circle 103 on Reader Service Card



. . . for mobile equipment

WHAT'S a hydrostatic transmission? This question of terminology kept reoccurring as AH editors gathered the design and application articles for this issue. Many users of this type of transmission just call it a rotary hydraulic drive. That's not sufficiently definitive.

• **Two types of drives:** Mobile equipment described in this issue obtain the power and control for travel motion from hydrostatic transmissions. These transmissions use positive displacement pumps and motors of either gear, vane or piston types. These positive displacement units handle the same volume per revolution regardless of load—neglecting slip, that is.

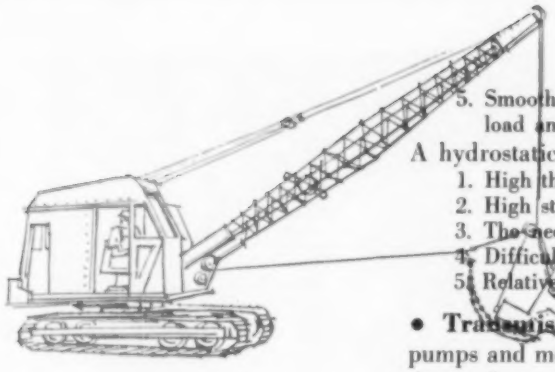
The pump supplies oil to the fluid motor at a pressure determined by load requirements. The motor develops the driving torque. This torque depends on system pressure and fluid motor displacement. Suitable valving to control direction speed, and torque completes the transmission.

Since the oil returns to the pump with the same velocity with which it left, there is no kinetic energy transfer, so the system is called hydrostatic.

The second type of drive, a hydrokinetic transmission, is only mentioned here to emphasize that it is an entirely different animal. This widely used automotive drive does not have positive displacement characteristics. Instead of transforming fluid pressure energy into useful torque, as is done with a hydrostatic transmission, fluid velocity energy is used.

• **Advantages and limitations:** In a paper presented by International Harvester's H. V. Parsley, before an SAE National Tractor Meeting, these advantages for a hydrostatic transmission were cited:

1. Extreme flexibility in installation; the power may be transferred to some inaccessible place through tubes or flexible hose.
2. The transimission may be preset or varied under load to maintain practically any speed ratio through wide variations in torque.
3. The transmission may be reversed or idled by means of a simple 4-way valve.
4. Precise control, as far as speed and travel are concerned, is obtained.

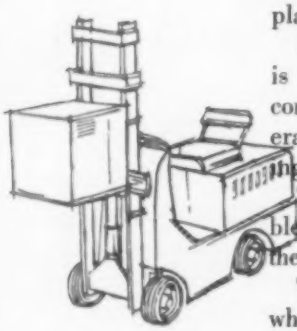


5. Smooth, uninterrupted variations in speed and torque ratios, overload and shock protection are readily obtained.

A hydrostatic transmission has these typical disadvantages:

1. High thrust and radial loads on its bearings.
2. High stresses in some of its other parts.
3. The necessity for extreme accuracy in machining.
4. Difficult sealing problems.
5. Relatively high weight and cost.

• **Transmission Characteristics.** Today, fixed displacement pumps and motors are being used on most mobile equipment. While the performance provided by variable displacement units would be desirable, their cost is at least three times greater than fixed displacement units at pressures over 1500 psi.

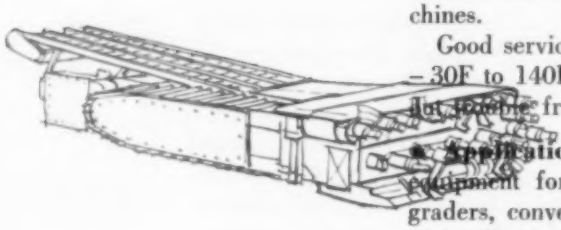


However, on mobile equipment, the power unit driving the pump is usually an internal combustion engine. Since its speed is easily controlled, the pump delivery can be varied. Combinations of several fixed displacement pumps and unloading controls are also being used to approach performance of variable delivery units.

The coal mining equipment described in this issue does use variable displacement units. Initial cost is not the concern that it is on the other types of mobile equipment.

The hydrostatic transmission is generally better suited for service where high shock loads, overloads, stalling and frequent speed changes or reversals are encountered than any other type. This describes the service of many slow moving, hard working mobile machines.

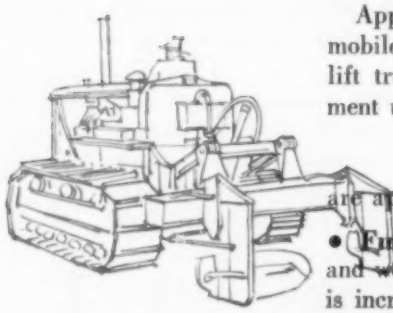
Good service is obtained over an ambient temperature range of −30F to 140F or higher. Properly designed systems operate without trouble from atmospheric dust or dirt.



• **Applications:** The hydrostatic drive is being used on mobile equipment for such operations as: blade angle control on road graders, conveyor drives for coal and other product handling devices; digging drive on a ditcher; crane boom rotation; drum rotation on a concrete mixer, and for hydraulic power steering.

Application of the hydrostatic drive for powering the travel of mobile equipment is relatively new, particularly in such areas as lift truck design. Engineers developing drives for mobile equipment used in:

material handling • *agriculture* • *construction*
coal mining • *railway maintenance*



are applying the hydrostatic drive for powering travel motion.

• **Future developments:** Mr. Parsley stated that he believes cost and weight of hydrostatic transmissions will decrease as production is increased and higher pressures are accepted. There's a definite trend to increased use of hydrostatic transmissions in mobile equipment. ▼▼▼

You'll get ideas about what is being done today and planned for tomorrow from the articles in this issue.

HYDROSTATIC TRANSMISSIONS ... for agriculture

• *By Sir George Dowty*

Chairman & Managing Director of The Dowty Group of Companies, England

• **Hydrostatic drives:** Undoubtedly these drives will supersede the conventional mechanical change speed box on tractors. The advantages to be gained are:

1. Infinitely variable speed ratio,
2. Simplified control,
3. Improved performance, and
4. Greater freedom in vehicle layout.

• **Experimental design:** The tractor described in the following article has demonstrated that a hydrostatic transmission is practical and is capable of high efficiencies. The great problem lies in producing these drives at a price which is attractive to the vehicle designer.

Hydrokinetic and hydrostatic drives each have their special applications.

The hydrokinetic torque converters provide a limited speed ratio which is determined by the input speed and the output load. Maximum efficiency is achieved when the speed ratio is at its minimum, but this performance can be extended by the use of supplementary mechanical gearing. Hydrostatic transmissions on the other hand provide a speed ratio determined by the setting of the displacement members. Speed ratios up to 8:1 give good efficiencies when both pump and motor displacements are variable. Efficiencies from 85 to 95 percent have been achieved over a wide range of speeds and loads.

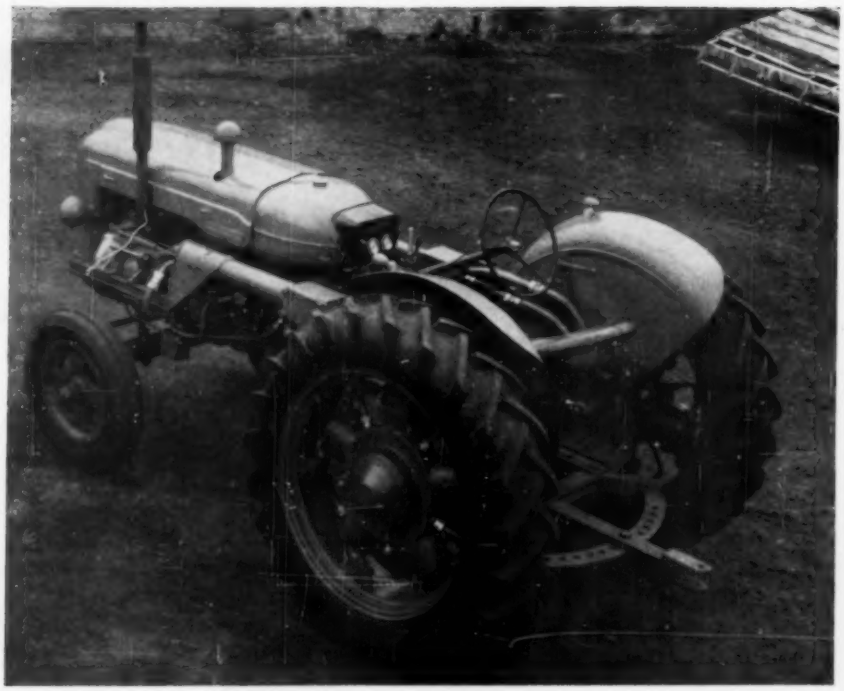
• **User acceptance:** No other transmission allows the same choice of forward speeds, or permits the forward speed to be held independently of tractive resistance or varied according to working conditions as does the hydrostatic drive. Other advantages are:

1. Ability to drive a powered implement at constant speed irrespective of forward speed.
2. The use of full engine power at any speed subject only to wheel adhesion.
3. Improved fuel economy resulting from a reduction of the engine speed range.
4. Elimination of shock loadings.

• **Cost problem:** We expect to see hydrostatic drives for tractors in the next 2 to 3 years. The first vehicles may be of conventional design, but the greater freedom permitted by the elimination of mechanical drives will permit the development of vehicles of less orthodox designs. This also applies to many other types of "off-the-road" vehicles several of which, such as shovels and loaders, are often based on a tractor. In these applications, the braking and rapid maneuverability made possible by the single lever control can greatly increase the working capacity of the machine.

One approach to lowered cost is the use of higher pressures, thereby reducing the size of all units, and from developments now in hand this looks a promising solution. ▼▼▼

• By H. J. Hamblin



FLUID MOTOR IN DRIVE WHEELS

... simplifies tractor design

Fifty years ago much work with a hydrostatic drive on tractors didn't lead to success. Why should this drive be successful today? Here's the story of an experimental design disclosed early this year by The Institution of British Agricultural Engineers.

TRACTORS are particularly suitable to be driven hydrostatically because they travel at low speeds and do not need to be exceptionally light, so that the classical objections to a hydrostatic transmission, inadequate speed and excessive weight, are irrelevant.

Designers of the experimental tractor seen in Figure 1 chose to build the fluid motors into the driving wheels. Figure 2 is an exploded assembly photo of this direct fluid drive. This arrangement has the advantage that the motors occupy space that is otherwise unused and that a driven wheel of this type could very easily be steered. From the hydraulics point of view the advantage of such an arrangement is that the motor is slow running so that churning losses should be low and efficiency high.

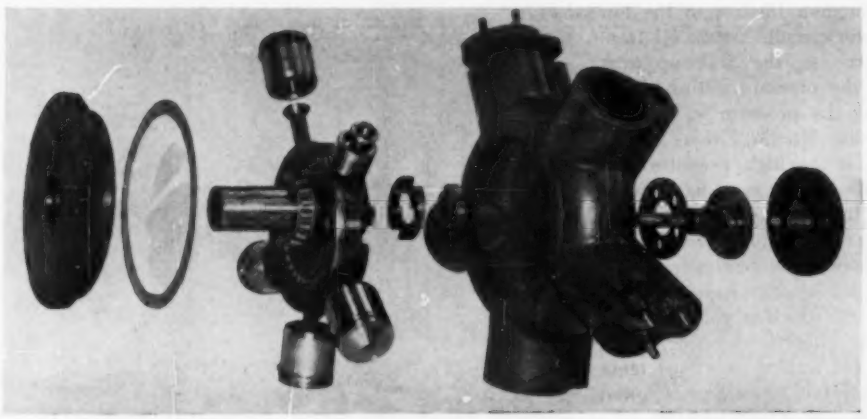
Here's how this fluid motor, designed for 3000 *psi max service operates*:

The five cylinder casing is supported on bearings carried on a stationary shaft flange-mounted on the tractor. Part of the stationary shaft is in the form of an eccentric that carries a double-row roller bearing on the outside of which bear white metalled pads connected to pistons operating in the

H. J. HAMBLIN, *Head of Mechanical Engineering Development, The Institution of British Agricultural Engineers*

FIG. 1. EXPERIMENTAL TRACTOR having fluid motors built into the driving wheels. Oil pipes to the motors pass through tubular side members.

FIG. 2. EXPLODED ASSEMBLY photo shows parts of the piston type fluid motor designed to drive the tractor.



cylinders. A trapped ball transmits the thrust from each piston through a short column to the associated pad. Each cylinder is connected by an oil passage to a hole in the outside face of the motor casing where a matching hard-faced plate is located. Oil passes to and from the cylinders through the stationary shaft, which is hollow, and distribution takes place through a simple, pressure loaded stationary face valve.

When the motor is rotating forward, oil passes down the central tube to the valve and is returned through the annulus between the central tube and the inside of the stationary shaft. To reverse the motor, the direction of flow of the oil is reversed.

The motor is intended to run with the casing full of oil, Excess oil escapes through a passage drilled in the eccentric and along the stationary shaft.

Any leakage taking place from high pressures in the circuit, irrespective of the direction of rotation, is an internal loss, and the only seal to the atmosphere has no greater duty than is commonly required in mechanical transmissions. Considerable use is made of O-rings.

The valve used in this motor is the simplest type of face valve. It is an iron casting and is specially faced with hard chromium or other suitable material but otherwise it represents the simplest and crudest solution of the problem of distributing oil in the motor. The full pressure of the high pressure side of the circuit is allowed to act on the back of the valve, and the valve is badly unbalanced both end-ways and across. This simple, but theoretically, undesirable valve was used to see what would happen and, although experimental work is now moving towards examining more complex arrangements, the simple valve can be made to work quite well.

The bore and stroke of the motor are 3⅞ in by 2¾ in. The maximum piston thrust is about 35,000 lb and the load on the white-metalled pads is about 1.3 tons per square inch. The pistons have a clearance of .002 to .003 in. in the cylinder bores. Two cast iron rings per piston are used as a seal. The valve face and its mating surface are hand-lapped to a finish of a few micro-inches.

PUMP DESIGN

A modified axial piston, variable volume pump was developed for this transmission. It is smaller than a commercially available unit. Even with this modified design, size is still a problem. The pump was a "quick" design to get a tractor in the field, and was not subject to any experimental work. It

gives a flow in either direction of 62.5 gpm at an engine speed of 1600 rpm. The tractor operator manually positions the pump tilt box to control its displacement from near zero to maximum delivery in both directions.

HYDRAULIC SYSTEM LAYOUT

Figure 3 shows the circuit used on this experimental tractor. The two motors are connected in parallel to the pump in a closed circuit. A small pump is provided to draw oil from a make-up tank and pump it, through a filter, into the low pressure side of the main circuit. Excess oil from this boost pump returns to the make-up tank through a relief valve, the pressure setting of the relief valve determining the pressure in the low pressure side of the main circuit. Either side of the main circuit may be the high pressure one, depending on whether the tractor is going forward or backward and whether it is pulling or overrunning, and means has to be provided for the boost pressure to be applied, automatically, to the low-pressure side. This can be done by a pressure-actuated change-over valve, which is what was used on the tractor, or, more simply, by check valves as shown in Figure 3. Oil leaking from the main circuit into the pump and motor casings is allowed to return to the make-up tank.

The boost pump is placed suitably low in relation to the make-up tank and is connected to it by a large pipe so that all points in the circuit are at a pressure above atmospheric and therefore, air will not be drawn into the system. If the pipe connecting the make-up tank to the boost pump is too small, the pressure drop along it may be sufficient to make the pressure at the inlet of the boost pump sub-atmospheric. In this case, the system will tend to draw in air.

DESIGN STEPS

1. Decide on a maximum motor torque and system pressure.
2. Calculate motor capacity using this formula based on 85% motor efficiency:

$$C = 88.75 \frac{T}{P}$$

Where P = maximum pressure in psi
T = maximum torque in lb-ft
C = swept motor volume per rev in cu in

3. Knowing the effective rolling radius of the driving wheels, determine pump capacity to drive selected motor at desired top speed.

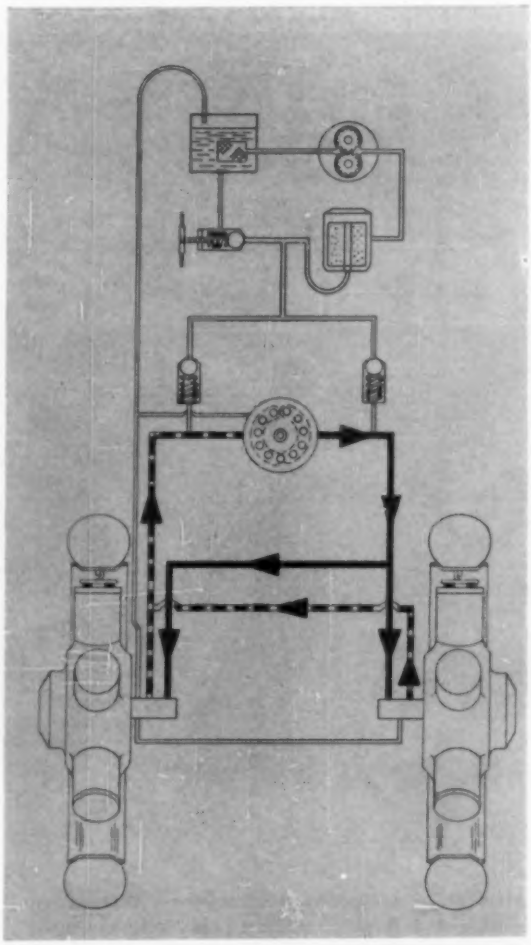


FIG. 3. SCHEMATIC of the hydraulic drive circuit shows the fluid motors connected in parallel to the pump in a closed circuit.

An additional advantage of boosting the circuit is that it greatly reduces the risk of cavitation at the pump inlet. This feature might prove important with a pump running at a higher speed than that used on the tractor.

Since oil circulation through the make-up tank is, only a fraction of the flow in the main circuit, it is practicable for the make-up tank to be only a fraction of the size of a reservoir designed to suit the main circuit flow.

In this circuit, there is no differential regulation of the flow from the pump to the two motors. The flow from the pump comes to a Y-joint and each motor can take the amount it requires. The effect is precisely the same as with a differential gear in a conventional transmission.

TRANSMISSION PERFORMANCE

There is no trouble from the cyclical speed variation in the motor which is absolutely unnoticeable

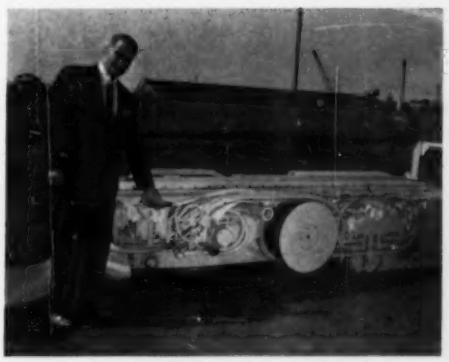
Continued on page 80

HYDROSTATIC TRANSMISSIONS ... for mining

• *By Joseph J. Slomer*
Hydraulic Engineer, Goodman Manufacturing Co.

• **Hydrostatic vs. Mechanical:** In designing drives for coal mining machines where speeds are low and power requirements not too high, we have found the control features of hydraulics to be superior to mechanical systems. The hydraulic control is easier to handle; there is a minimum of power wasting slippage and no wearing of clutch parts. Because of the pressure limitation, breakage of cutting tools is negligible in contrast to mechanical systems where it is a problem. Another advantage of the hydrostatic system is that the motor can stall without damage. Two of the difficulties with the hydrostatic system are contamination of the fluid and training of maintenance personnel.

• **Developing the Drive:** Many problems of applying a hydrostatic drive to a mining machine were solved on our continuous boring machine first produced in 1953. The power source for the drive was a 20-gpm, variable-volume, pressure-compensated pump operating between 1200 psi and the relief valve setting of 3000 psi which is approximately the slipping point of the tractor treads. Two flow-control valves formed a flow divider to vary flow to drive motors for each crawler.



MR. SLOMER points out features of a hydraulically driven, extensible, belt supported conveyor. This recently developed machine is used as a movable collector for a mining loader or borer.

Because the original machine had no brakes, steering was difficult, and either crawler would carry the other, driving the inactive motor as a pump.

One design to solve this difficulty was to connect the motors in parallel and install braking valves. However this arrangement produced over-speeding of one of the motors when full braking was applied, and an additional flow regulator had to be used in each motor circuit.

A recent design uses a servo-controlled, cross-over-center pump, and eliminates directional control valves. Steering is accomplished by brake valves. This control has proved the easiest on the transmission equipment and most trouble-free.

• **Performance:** The fluid motors rotate at 3140 rpm and drive through a total reduction of 500:1. Cutting speed varies from 6 in/min to about 2 ft/min. Full speed using additional output from the conveyor pump and a gear ratio of 357 is 30 ft/min.

• **More Hydrostatic Drives:** We are adding more hydrostatic drives on new designs and are working on improvement in pump controls. In the future as higher speeds are required, cross-over-center pumps will be used without directional control valves. ▼▼▼

After experimenting with direct control and a mechanical feedback servo system, a hydraulic feedback system for pump control was developed on this mining machine.

SERVO SPEED CONTROL

. . . for a

● By E. M. Arentzen and D. J. Arnold

MANY hours of development, testing in the mines, and redesign have gone into this continuous mining machine. The conditions existing three or four miles back in a coal mine are difficult to match for the challenge they present to a hydraulically operated machine. Dust-laden atmosphere, lack of ventilation and cooling, and limited maintenance facilities require special techniques in the hydraulic design of the equipment.

In addition, the factor of safety is of extreme importance when your machine is chewing through the coal face at the rate of two tons each minute through a coal seam as little as 40 inches high. If the ceiling should crack, the operator must be able to move this 20-ton machine back quickly. Controls must be simple and fast acting. Speed must be controlled according to the hardness of coal being cut and the size of the coal face. The machine must not stall if the cutters hit a hard sulpher ball. It must develop the necessary momentary power to overcome this and continue to move forward at the speed selected by the operator.

E. M. ARENTZEN, *President, Lee-Norse Co., Charleroi, Pa.*
D. J. ARNOLD, *Field Engineer, Denison Engineering Co., Columbus, Ohio*

In addition to these controlled speeds for cutting coal, the mining machine must have a fast speed for tramming—moving to a new location. The controlled speeds should cover about 30% of the speed range. Above this the machine should accelerate quickly to full speed.

These were some of the requirements considered by Lee-Norse Co. in developing the hydrostatic drive for their continuous mining machines.

The first system consisted of a variable-volume pump supplying two fixed displacement fluid motors, one driving each crawler. The axial piston pump was controlled directly by the operator who actuated a pump control piston which regulated the angle between pump pistons and pump drive shaft and consequently the output from the pump to the motors. This "open-loop" system required the operator to move the throttle according to the hardness of the coal face. When a hard spot was encountered, the motor would stall dumping oil over the relief valve in order to maintain a fixed speed.

The second method which was tried was to design a servo control for the pump with a mechanical feedback to the operator's control. While this system eliminated the constant "hunting" required by the operator, it wasted power. When the operator set his control for more delivery than the motors could accept, the excess had to flow over the relief valve, resulting in a power loss. An additional disadvantage of this system was the difficulty encountered with the mechanical linkages

MINING MACHINE chews through coal face at rate of two tons per minute. Pressure compensated speed control permits power savings in the hydraulic system and constant speed regardless of coal hardness.

hydrostatic drive

FLUID MOTOR SPEED is selected by throttle valve connected in a meter-in circuit. Pressure compensation is provided by the sequence valve which controls pressure on the pump control piston. This hydraulic-feedback servo system ensures constant speed regardless of the load on the motors.

used in the feedback arrangement.

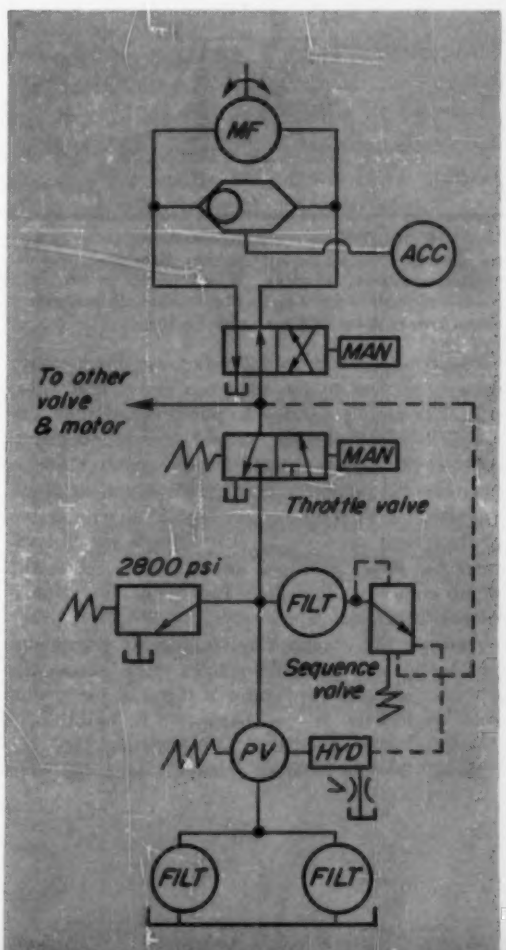
The present design of speed control makes use of a tapered-spool, 3-way throttle valve connected in a meter-in circuit with the fluid motors, and a sequence valve connected to control the variable volume pump and maintain a constant pressure drop across the throttle valve. Load pressure is fed back to the sequence valve to form a servo circuit controlling pressure on the pump control piston.

CIRCUIT OPERATION

The pump is stroked by an integral hydraulic piston which acts against a spring. The spring acts in a direction to place the pump on stroke, so that when no pressure is applied to the piston, the pump delivers full volume. When a pressure of 380 psi is applied to the pump control piston, the pump pistons are positioned so that they rotate nearly concentrically with the drive shaft and the pump output is only enough to maintain the 380-psi pressure on its control cylinder.

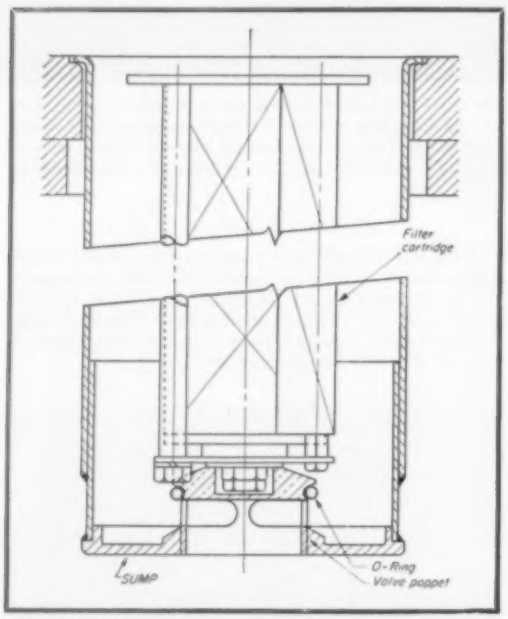
Output from the pump is connected to the throttle valve which has a very slow taper ground on its spool. This taper permits the valve to act as an "accelerator" delivering an amount of fluid to the motors according to its position.

The sequence valve is connected in the circuit to maintain a constant pressure drop across the throttle valve, so that flow is constant for any setting regardless of the load. The sequence valve compares pressures on each side of the throttle



valve and maintains this ratio constant for any setting of the throttle valve. The input of the sequence valve is connected to pump output, and the output of the sequence valve is connected to the pump control cylinder. The load side of the throttle valve is connected to the sequence valve, so that load pressure acts with the 35-lb spring on the top of the sequence valve piston.

To illustrate action of the throttle valve, consider the valve at a certain setting with the motors running at a corresponding speed. If the throttle valve is then opened to increase speed, pressure drop



FLOATING COVERS were provided for filter sumps to maintain oil in pump suction line and prevent cavitation during starting. When pump is running, covers are raised by 3½-in Hg suction. When pump stops, covers drop and seal with O-ring.

across the valve will decrease. Because this pressure drop is applied to the sequence valve, that valve will offer more resistance to pump output and consequently more pressure drop to the pump piston control. Decreased pressure on the control piston positions the pump for greater delivery as originally called for by the throttle valve. Analyzing action of the circuit when the throttle valve is closed indicates the opposite effects so that pressure on the pump control is increased and the pump is positioned for a smaller delivery.

Because the sequence valve controls pump output to achieve pressure compensation across the throttle valve, forward speed of the machine is constant regardless of coal hardness. In addition, a power savings is achieved over previous methods, because only the required volume is delivered from the pump and no oil is dumped over the relief valve except under abnormal conditions.

Speed of the miner is under control of the operator for system pressures to 2500 psi which is the setting of the relief spool of the sequence valve. At pressures above this value the sequence valve is vented and opens completely. This applies full pressure to the pump driving it to near-zero stroke and stopping the forward travel of the machine.

The throttle valve is machined to control the pump from 0 to 20 gpm so that the miner can be controlled at speeds around 5 ft/min while cutting into the coal face. Maximum speed for tramming with the 35-gpm pump is 80 ft/min.

COMPONENTS

The throttle valve is a standard, 4-way manual valve with a fine taper cut on the spool land to permit speed selection. The sequence valve is a standard 5000-psi unit with a special spool for this application. In the standard, pressure balanced sequence valve, the spool has a 10% greater area on the top than on the bottom to provide good sealing below the pressure setting of the valve. In this application however the areas on both sides of the spool are equal, so that the slightest change in the relationship of pressures on both sides of the throttle valve will cause the pump to react.

FILTERS

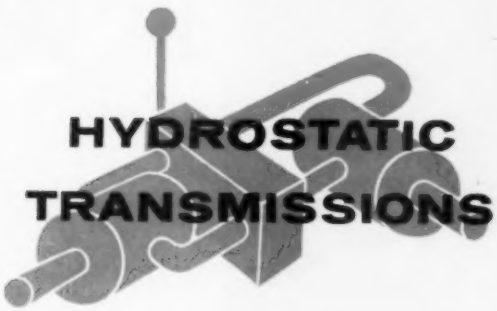
One problem which was solved after considerable testing was the filter installation. During actual operation in the mine, the pump was noisy and the difficulty was attributed to air in the system. It was finally discovered that the filter caps were being tightened too much causing cracks and consequent aeration. New covers were designed for the 40-micron, blade-type filters.

Another problem solved by re-designing the filter installation was caused by the fact that the pump is mounted 8 inches above the reservoir oil level. During idle periods oil would drain out of the pump. When the system was again started, about 5 seconds were required for the pump to prime, and some cavitation occurred during this period. To correct this situation, floating covers were designed for the filter sumps. When the system is in operation, these covers are raised by pump suction of about 3½ in Hg and allow fluid to pass freely through the filter. When the pump is stopped, the covers drop, trapping fluid in the pump and filters. The aluminum and bronze covers seal with an O-ring.

The axial piston pump is positioned by pressure applied to its control piston acting against a spring. The control piston forces the pump to zero stroke; the spring forces the pump to full stroke. A needle valve in the connection to the control piston bleeds off oil from the control piston. When the pump is idling with the throttle valve closed, the pump de-

Continued on page 81

• *By Sterling F. Winchell*
Chief Quality Engineer, Warner & Swasey Co.



. . . for construction

• **More Fluid Power:** The recent trend toward increased use of hydraulics in construction equipment parallels a similar trend in other types of machinery. This is brought about by several factors. Hydraulics provides a convenient method for translating a large amount of force from a conveniently located standard power source to the point at which torque or thrust is required to perform a function. Thrust or torque is available in a compact and relatively small size output unit. This method has many advantages because power can be delivered around corners without the expense and inconvenience of gear trains, levers, cables, pulleys, and other similar means.

• **Leakage:** The most troublesome problem in the application of hydraulics has been that of leakage. Leakage problems increase as pressures increase. Leakage causes loss of efficiency, malfunction of controls, and is objectionable because of appearance and cost. Excess external leakage is particularly serious on construction equipment because it drips on the highways and other places.

To eliminate this No. 1 problem, improved cylinder packing and cylinder designs have been developed, including better hose fittings and leak-proof connections. Manufacturing methods for obtaining round, straight valve bores to close tolerances have become a requirement. More efficient pumps and motors which operate at higher speeds and pressures have also been developed.

• **Cylinder damage:** The next serious problem with hydraulic construction equipment was that of scoring and galling of cylinders and cylinder rods. This problem increased as loads and pressure increased. Considerable success has been obtained by proper cylinder, piston, and rod design. At present, the causes of cylinder scoring are operator abuse, improper maintenance, and contamination of hydraulic systems.

• **Pump Improvement:** The third hydraulic problem for heavy construction application was the lack of high speed, high pressure, pumps, which would have a long life at high efficiency and low replacement cost. Fortunately the demands have resulted in considerable improvement in hydraulic pump design in the high volume, 1000-3000 psi range, and improvements are in process to operate efficiently at higher speeds.

The Gradall, described on the following pages, was one of the earliest all-hydraulic pieces of construction equipment, and was responsible for many hydraulic improvements.

DUAL

• By William M. Shook

FIG. 1. TO MODIFY the rubber-tire mounted machine to this track mounted unit, two fluid motors were added with no increase in pump capacity. By the proper valve arrangement, the operations which can be performed at the same time are regulated, so that the original pump capacity is sufficient.

Use of two dual gear motors to drive the tracks of this grading machine provides 40 hp at two speeds of 1 and 1/2 mph.

VERSATILITY is one of the key features of the Gradall, an earthmoving machine for performing multiple operations. To further the versatility of the rubber-tire mounted equipment, the machine has now been adapted for hydraulically driven tracks.

The first approach in adapting the rubber-tire mounted equipment to a crawler type undercarriage was a direct mechanical drive. The first step was to build a new power take-off on the engine to accommodate this mechanical drive as well as the hydraulic system pumps. This involved a special power take-off for the crawlers with all the special tooling and castings required, as well as the troublesome clutches, drive shafts, and right angle gear drives.

WILLIAM M. SHOOK, *Chief Gradall Engineer, The Warner & Swasey Company, New Philadelphia, Ohio*

FLUID MOTORS

. . . for two speed control

Therefore, it was decided that it would be best to use the existing hydraulic system for the drive rather than a mechanical drive.

Because all operations of the boom and attachments as well as control of the upper section were already completely hydraulically driven, adapting the equipment to hydraulic track drive was basically only a problem of adding two fluid motors and auxiliary control to the hydraulic system.

Although the two 40-gpm pumps which supply the track drive also supply circuits for raising and lowering the boom and extending and retracting it, open-center valves connect the pump delivery to the track circuit when the boom is not operated. Three additional circuits for operating the boom, and rotating the upper section of the machine are powered by a 15-gpm pump mounted in tandem with the two 40-gpm pumps. The three open-center valves which control these circuits are connected in series so that only one operation can be performed at a time, and the pump supplies only the active circuit.

3-PUMP UNIT

The three pumps are enclosed in a single case and mounted as a unit to a special bell housing on the 4-cylinder gasoline engine. The engine develops 70 to 75 hp and runs at 1500 to 1600 rpm under load. This method of mounting aids in proper alignment of the pump shaft with the engine driving shaft.

The 100-gal reservoir is mounted on legs above the pump and connections to the pump are made with three rubber hoses. This arrangement ensures that the pump suction lines are always full of oil and prevents starvation and cavitation of the pumps.

The two dual fluid motors shown in Figure 2 are geared together by a gear box and drive a central shaft concentric with the pivot which permits rotation of the upper section of the machine. This chain-driven, vertical shaft transfers the driving power through bevel gears, and clutch-brakes to the track drive axle. This axle drives the track sprockets through chains. The drive axle and brake-clutches are shown in Figure 3.

MOTOR CONTROLS

Controls for the track drive consist of two steering levers and a speed control lever. The steering levers are mechanically linked to the clutch-brakes on the drive axle, and steering is accomplished by driving one track while the other track is braked. The steering lever has four positions and a neutral setting permitting selection of two forward and two reverse speeds. The lever is linked to the four 3-position valves controlling the two dual motors. In the first position of the lever, either forward or reverse, two of the valves are actuated to admit fluid for high speed operation. In the second position of the lever, the second set of valves are opened to admit fluid to the motors for low speed operation.

Especially intended for swamp drainage, land reclamation, and irrigation work, the track mounted machine is powered for 30% grades. It has a weight of 31,590 lb. The crawler length is 9 ft. 11 in. and shoe widths range from 18 to 48 in. Various combinations of shoe and frame widths permit bearing pressures from 3.5 to 9.0 psi.

At top speed the motors rotate at 1200 rpm. Speed reduction in the gear box and chain drive results in a speed of 45 rpm at the center pin and

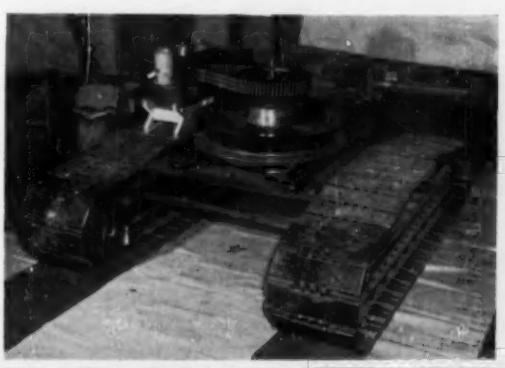


FIG. 2. TWO VERTICALLY MOUNTED FLUID MOTORS are geared together to chain drive the center shaft. The chain drive from the drive axle to the track sprocket is also shown.

a speed of 1 mph of the machine. At low speed the motor speed is 600 rpm resulting in a machine speed of ½ mph. The power output from the two fluid motors remains constant at 40 hp. The gear type motors were chosen because of their simplicity of design, and because they provide adequate braking and satisfactory starting torque. They have a lower cost than other types of fluid motors.

VALVE OPERATION

In the circuit diagram of Figure 4, open-center valves *E* and *F* connect the pump output to the fluid motor circuit when not actuated by controls for raising and lowering, and extending and retracting the boom. Valves *A*, *B*, *C*, and *D* are actuated by the track speed control lever. In the first step forward position of the lever, valves *A* and *C* are actuated together admitting fluid to each fluid motor for fast speed forward. In the second forward position of the lever, valve *B* and *D* are actuated to admit fluid to each fluid motor producing slow forward speed.

When valves *B* and *D* are centered, the corresponding pump sections are connected to tank. When valves *A* and *C* are centered, the pumps are unloaded and the fluid motor sections in parallel form a circuit through one of the 1500-psi relief valves which acts as a brake valve. Which of the 1500-psi valves is in the circuit depends upon the direction of rotation of the motors. ▼▼▼

FIG. 3. DRIVE AXLE and clutch-brake units for steering. Vertical shaft, concentric with pivot for machine top section, drives axle through bevel gears.

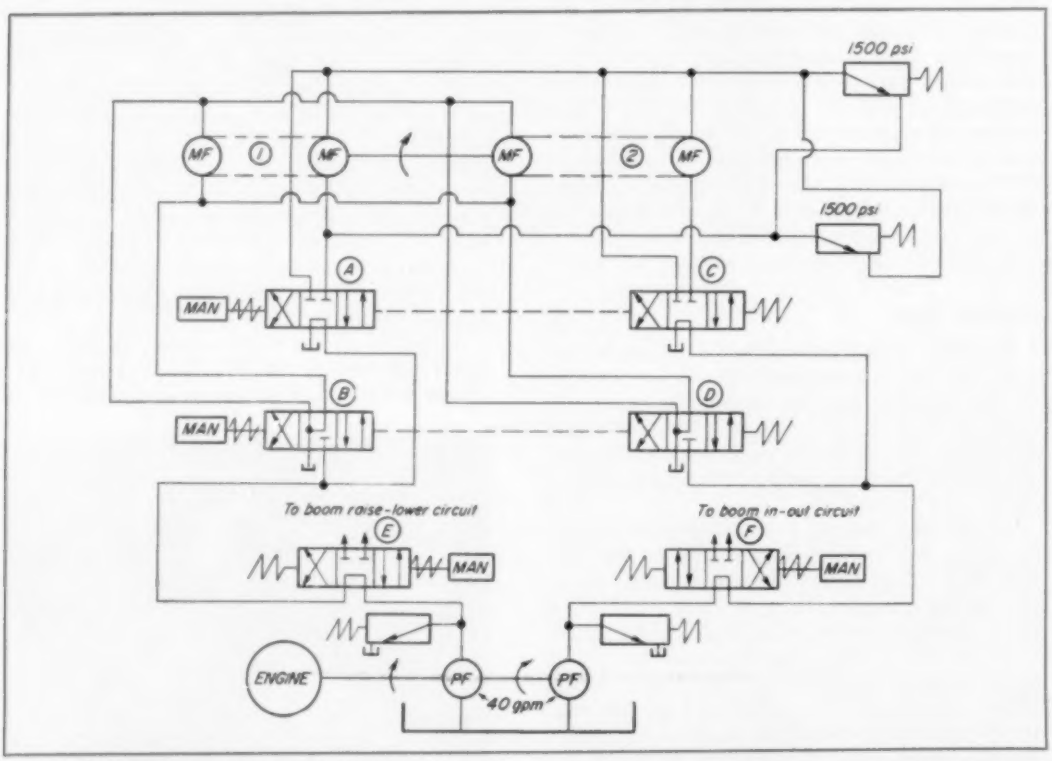


FIG. 4. TO CONSERVE PUMP CAPACITY valves *E* and *F* must be in center neutral position for operation of the track drive. Valves *A* and *C* are mechanically connected to control fluid flow to each motor for high-speed operation. Valves *B* and *D* are connected together to control flow to each motor for low-speed operation. One of the 1500-psi relief valves forms a braking circuit with the associated motor sections depending on the direction of rotation of the motors. Pumps are unloaded through valves *A* and *C*.

• *By E. J. Powell*
Railway Maintenance Corp.

HYDROSTATIC TRANSMISSIONS ... for railway maintenance

Mr. Powell tests operation of the Super Mole ballast cleaner.

• **Simplicity of operation** is one of the most desirable characteristics offered by hydrostatic drives on railway maintenance equipment. Because the machines in this field are only recently replacing hand labor for track alignment, tie replacement, and ballast maintenance, experienced equipment operators are scarce. All-hydraulic and air-operated equipment require a minimum of experience before the operator becomes proficient.

• **Many of the operations** performed on railway tracks require the large forces possible only with fluid power—track alignment for instance requires a 12½-ton push. Because of this necessity for a fluid power system and the requirement for slow, controlled speeds, most of this company's machines have hydrostatic drives for propulsion during track maintenance. A combination design of fluid power and mechanical drive is also used, so that a fluid motor or air motor drives the vehicle from a power take-off with the engine clutch disengaged. An overrunning clutch then permits the engine clutch to be engaged for moving the equipment to a new work location.

The overrunning clutch prevents the fluid motor from acting as a pump when the vehicle is propelled by mechanical drive. In a machine such as the ballast distributor, operating speed is 800 to 1200 ft/hr and traveling speed is 18 mph.

Not only is speed easily controlled with a hydrostatic drive, but there are several methods of obtaining this control—both with flow control valves and a variable pump output. One method used on the ballast distributor is to have one pump for each of three fluid motors. Two of these motors drive the conveyors during ballast distribution operation. When traveling speeds are required, the two pumps which supply the bucket conveyors are connected to the propelling fluid motor.

• **Field maintenance** is one of the constant problems in designing and operating equipment of this type. It is almost always performed by personnel with little experience with fluid power. They must be cautioned to keep motors and pumps clean while they are being repaired. Piping must be kept free of dirt and thread cuttings, and care must be taken to prevent improper tightening of hoses.

Improved design of valve banks—especially for the higher pressures—and a greater availability of fluid motors in the torque range of 150 to 200 in-lb/100 psi will speed this increased use of hydrostatic transmissions. ▼▼▼

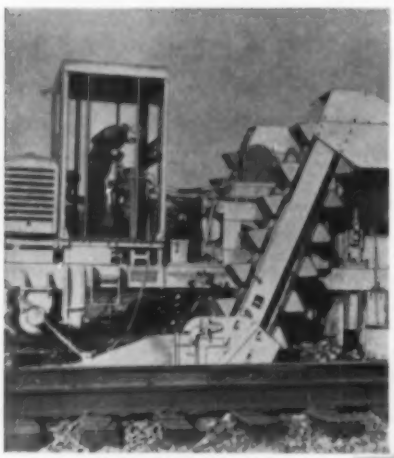
RAILWAY MAINTENANCE

. . . 100% fluid power

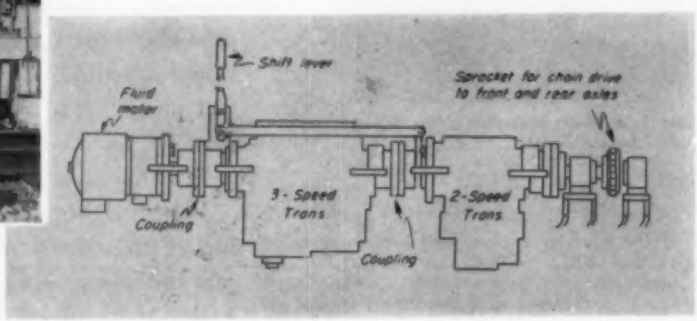
By E. J. Powell

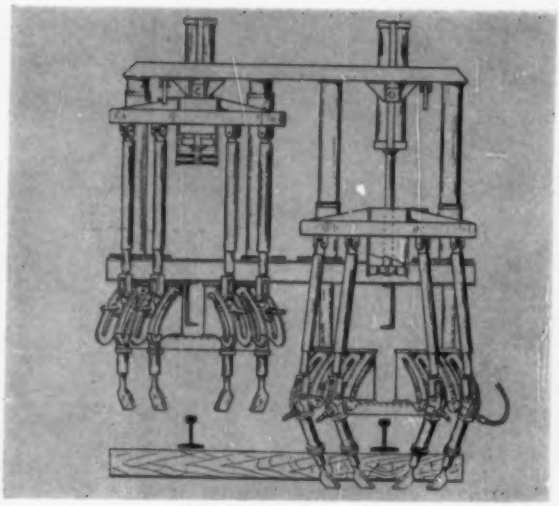
Railway Maintenance Corp., Pittsburgh, Pa.

First used in 1936, hydrostatic drives now power six track maintenance machines manufactured by the Railway Maintenance Corp., Pittsburgh, Pa. These machines are either completely hydraulic, using a fluid motor drive, or completely pneumatic using an air motor drive.



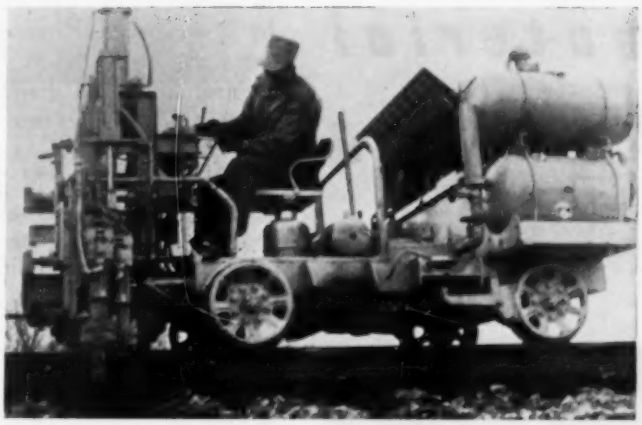
FLUID MOTOR DRIVES AXLES through two transmissions and a chain drive on this ballast distributor. Three-speed transmission has speed ratios of 5:1, 2:1, and 1:1. Two-speed transmission has ratios of 5.2:1 and 1:1. Drive provides working speeds of 800 to 1200 ft/hr and traveling speeds of 6, 18, and 30 mph. Motor is supplied by 19-gpm pump.

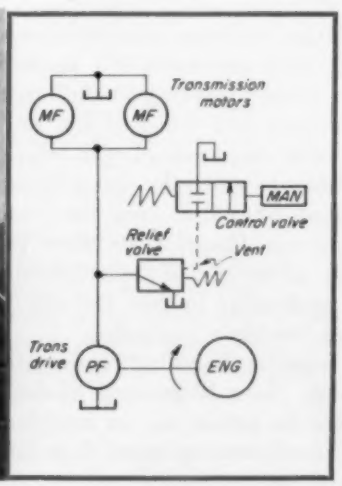




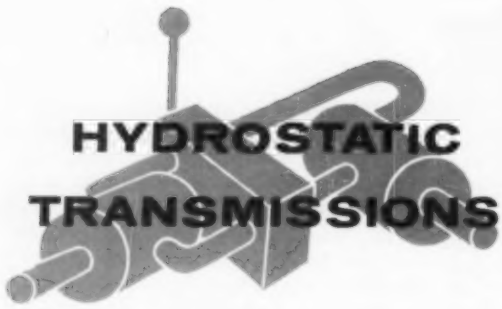
TIE TAMPING MACHINE is propelled by air motor driving through 3-speed transmission which permits working and travel speeds of 5 to 25 mph. Sixteen tamping tools, two head lifting cylinders, and propelling motor are supplied from Diesel-powered compressor. Split head design shown in diagram permits simultaneous operation of all 16 tools or individual operation of each group of 8 tools over each rail. One operator controls the tamping cycle, penetration under the tie, number of insertions and pressure on tampers.

AIR-OPERATED MACHINE for driving spikes is driven by air motor. Powered by 125-cu. ft. compressor, machine has speeds of 4, 6, 10, and 20 mph. In operation machine has air-operated tongs which lift up tie against rails. Pneumatic hammers then drive spikes. Each air hammer has automatic valve to start hammer on contact with the spike. Spotting the guns parallel with the rail is regulated by a hydraulic cylinder. Machine is equipped with a hydraulic ram turntable which enables the operator to raise the machine and remove it from the track.





WORKING SPEEDS of 800 to 2880 ft/hr are supplied by two fluid motors connected in parallel. These drive the main shaft through a chain and over-running clutch. The machine is built on a standard tractor, and when moving from one location to another it is driven through a standard transmission. Fluid motor drive is used for the slow working speeds. When the motors are not required, the corresponding pump is unloaded through its vented relief valve controlled by a manual valve. Mechanical drive is connected for speeds of 1½ to 5½ mph with engine speed governed at 1650 rpm. In addition to propulsion, hydraulic power actuates digging head, main conveyor, vibrating screen, dirt conveyor, and head lifting cylinders. Pressure for all operations is set at 1000 to 1150 psi, except for head lifting cylinders where pressure is set at 2500 psi.



. . . for material handling

• *By C. E. Smith*

President, Towmotor Corporation
Cleveland, Ohio

Last spring, at the Material Handling Exposition, a prototype of a fork lift truck using the hydrostatic drive described in Walter Shaffer's article on the following pages was shown by Towmotor to the public for the first time. This development, made economically practical by the use of commercially available fixed displacement pumps and motor, marks another advance in our Company's continuing program of improvement in product design and performance.

The potentialities of this most recent improvement have yet to be fully explored. We are already convinced, however, that it will prove of particular value in plants where space is tight, where maneuverability is important, and where smoothness and precision of operation are especially needed.

Mr. Shaffer's article describes the present status of the new drive's development. But what about the future—particularly as it affects the manufacturers of such necessary hydraulic components as pumps and motors?

To these suppliers of essential equipment, the development of this new lift truck drive not only represents a new application for their products but, in our opinion, a big challenge as well.

Our design engineers are not satisfied to call a halt to the research which has made this latest development possible. They are already thinking and talking of further refinements which concern new concepts not only in the design and application of components but in vehicle construction as well.

The extent to which the present new drive will be applied will depend, of course, upon the results obtained in actual day-to-day use. However, on some of our models of Towmotors the advantages of the hydrostatic drive are so obvious that for application to them the new drive is already scheduled to go into early production.

With materials handling representing as it does today on the average about 40 per cent of the cost of manufacturing throughout the nation, we are confident that our new hydrostatic transmission equipped fork lift trucks will make a substantial contribution. ▼▼▼

FIG. 1. Single foot pedal which actuates a two stage control valve for forward, reverse, stop and inch control is pointed out by Mr. Shaffer.

DRIVE DEVELOPMENT FOR A FORK LIFT TRUCK

• By Walter M. Shaffer

WHAT drive would be most suitable for a vehicle in which the operator is essentially parking all the time? A fork lift truck requires fine, smooth control to accomplish the many starts and stops, the maneuvering in narrow aisles and on ramps, and the creeping or inching as a load is raised, lowered or tilted on the forks. It is necessary to get this control at any engine speed with as little time lag as possible between control operation and truck motion. Operation of the tilt, hoist or accessories should not affect inching or creeping motion of the truck.

A hydrostatic transmission on the 4000 pound capacity truck shown in Figure 1 is a recent development by Towmotor engineers. A line of fork lift trucks equipped with the drive, shown schematically in Figure 2, represents years of study, construction and field developemnt. The result is improved efficiency in utilization of the truck.

WALTER M. SHAFFER, *Staff Research Engineer, Towmotor Corporation, Cleveland, Ohio*

Hydraulically, this development marks one of the initial applications for a positive displacement pump and motor drive on a rubber tired vehicle. This hydraulic system results in:

1. Excellent maneuverability.
2. Fine control while the load is being handled on the forks.
3. Simple, single foot pedal control of start, stop, reverse, creep and inch.
4. Smooth, automatic decrease in torque as travel speed increases.
5. A not unreasonable cost, considering its advantages and the stage of its development.

With so much working time spent in inching or creeping, there is much wasted energy. In a mechanical drive this lost energy can be measured in wear and the resulting maintenance costs for clutch friction surfaces. In the hydrostatic drive which does not have a clutch, this energy is absorbed as heat in the fluid which can be cooled by a suitable heat exchanger.

DRIVE DEVELOPMENT

SELECTION OF HYDRAULIC COMPONENTS

From the standpoint of component cost, a study of available pump and motor units led to the conclusion that either gear or vane type equipment would be required. The circuit, Figure 2, shows three constant displacement pumps driven in tandem by the engine. The circuit is arranged so that one of the pumps supplies the conventional hoist, tilt and handling attachment circuit on a lift truck, as well as the drive. This results in a cost credit for the drive due to a pump not being required only for the conventional hydraulic system. There is also an efficiency credit since the total displacement of this pump will be working when the truck is traveling. There is no power required to drive a non-working pump.

Power is transmitted to the rear wheels through a conventional drive axle. The fluid motor drives the pinion shaft of the axle.

Displacement of the fluid motor is such that with full delivery from the three pumps, motor speed is the same as engine speed. Since the mechanical transmission replaced by this hydrostatic drive has a 1:1 ratio in high gear, there is no need to change drive axle gear ratios. At maximum system pressure more torque is applied to the pinion shaft than can be sustained with the mechanical transmission.

SPEED AND DIRECTION CONTROL

A compound, two stage valve having a single foot operated plunger was designed to control operation of the fluid motor.

The first stage is the pump selector and creep control. During inching or creeping this stage allows only the flow from pump 1 to be metered to the fluid motor. During travel, the outputs of all pumps are combined to power the fluid motor.

The second stage performs the same function as any open centered, three position, 4-way valve. This stage directs the motor to forward or reverse rotation and stop positions.

Only one modification is made to the conventional hydraulic system control valve. In this circuit, when the valve's plungers are in neutral oil flows through it to the drive control rather than back to the main reservoir.

TORQUE AND SPEED CONTROL

With this hydrostatic transmission, torque output varies automatically with the load on the fluid motor shaft. It is entirely a function of system pressure which rises with load and is limited by the setting of a relief valve. Motor shaft speed depends on oil delivery. Essentially, the truck drive provides

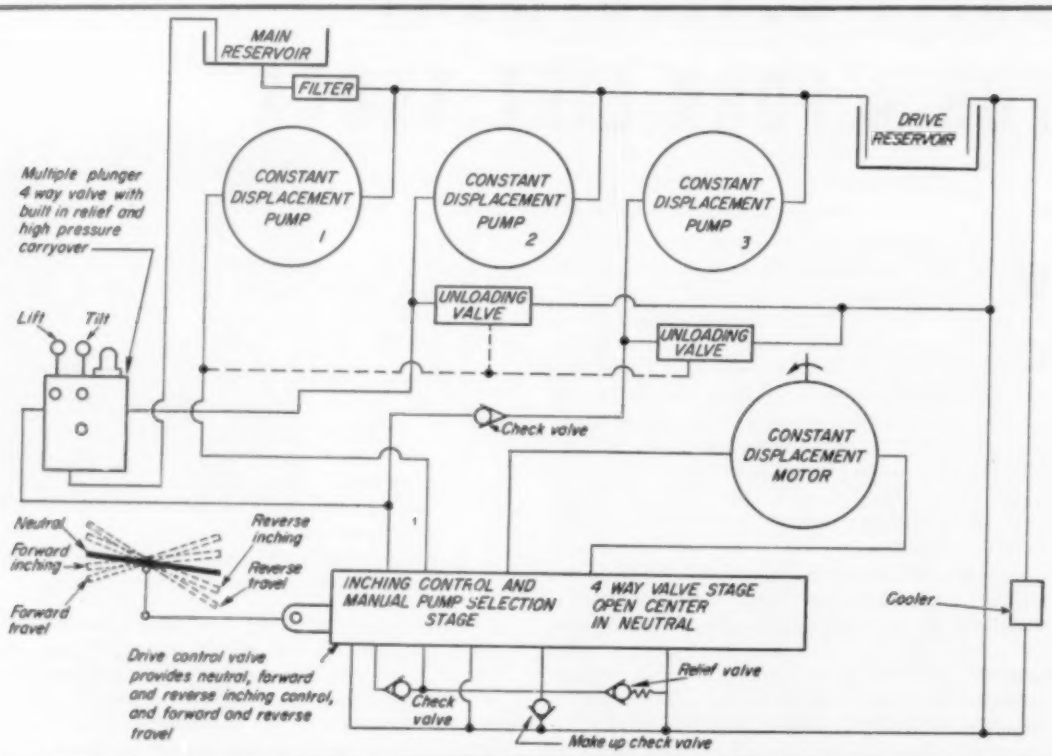


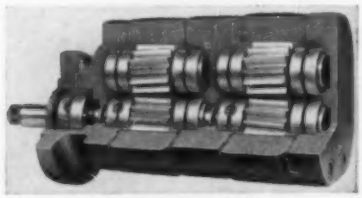
FIG. 2. FIXED DISPLACEMENT pump units supply oil to the fluid motor. Variable torque output is obtained by automatic unloading of pumps as system pressure goes up.

Hydraulic Motors Drive Crawler At Two Speeds

Two "Commercial" oil hydraulic tandem motors propel the crawlers of this Gradall. In fact you might say that there are really four motors as each tandem motor consists of two single motors. Here is how they operate to give the Multi-Purpose Gradall low and high speed ranges.

single or combined output

Two single motors are mounted with one common drive shaft. When fluid power from the pump source is directed by simple valving into just one of the single motors, the shaft rotates in the high speed range desired for propelling the crawlers where the going is on good level terrain. The other single motor on the same shaft receives no input and therefore idles at motor speed. When conditions are otherwise and low speed is required, it is accomplished by simply valving half of the fluid into each of the single motors. Because the volume feeding into each is less, the speed is reduced. Both tandem motors can be stopped or operated in either direction to give forward or backward travel to the crawlers.



Look at the heavy duty bearings which absorb the shaft and gear loadings. Perfect alignment of the matched helical gears results in more efficient, smoother, quieter and longer life operation.

50 h.p. output

As an example, an "H" Series single shaft tandem motor receiving an input of about 15 gpm at 1200 psi would rotate at 1200 rpm when the entire input was directed to only one of the two single motors. When this input is split between both motors, their speed would drop to 600 rpm. The example is based on two single motors mounted in tandem on a common shaft with each motor having gears of 1 inch face. Motors with larger gear widths are available to develop a rated output up to 50 h.p.

important advantages

All of this is accomplished without shifting of gears. Power takeoffs, clutches and gear transmissions are eliminated. Here is another proven application where fluid power is piped around corners. It is successful because space is conserved and high initial cost mechanical drives with their constant maintenance problem are eliminated. Write to Dept. **A-49**, The Commercial Shearing and Stamping Company, Youngstown, Ohio,

COMMERCIAL
shearing and stamping

Circle 27 on Reader Service Card

ARROW

AUTOPNEUMATIC CONTROL

for Complete Conditioning and Control of Compressed Air for Powering Pneumatic Tools—Cylinders—Valves and Appliances.

PIPE LINE SIZES
¼"
⅜"
½"
¾"
1"

THE BEST IS CHEAPEST

AQUAMATIC DRAIN TRAP

- Automatically Drains Out Collected Moisture in Filter Bowl
- Visible Operation
- Non-Corrosive Parts
- Stainless Steel Valve
- Double Sump Action
- Valve Prevents Air Locks
- Adaptable to Any Make Filter with ⅛" NPT Drain Cock
- Can Be Connected to Floor Drain

QUALITY of PRODUCTS
SERVICE to CUSTOMER
RELIABILITY to INDUSTRY
Has been ARROW POLICY
Since 1914

ARROW engineers and field consultants at your service.
Catalog and engineering data on request.

ARROW TOOLS, INC.
1902 S. KOSTNER AVE. • CHICAGO 23, ILL.

DRIVE DEVELOPMENT

Continued from page 76

automatic drive ratio selection. That is, as torque requirement goes down, speed goes up, and vice-versa.

Ideally, a hydrostatic drive giving these characteristics would use a variable delivery pump whose output decreases smoothly with rising pressure (torque). Cost prohibits use of such a pump. Use of two unloading valves in conjunction with the fixed displacement pumps in Figure 2, is an economical substitute for a variable displacement pump.

When drive system pressure is above approximately one-third maximum pressure, pump 3 is unloaded back to reservoir. When system pressure goes over two-thirds maximum pressure, pump 2 unloads, leaving only pump 1 to supply oil to the motor. Since opening action of the unloading valves is not an instantaneous action, these speed changes resulting from diverting pump delivery back to tank are smooth.

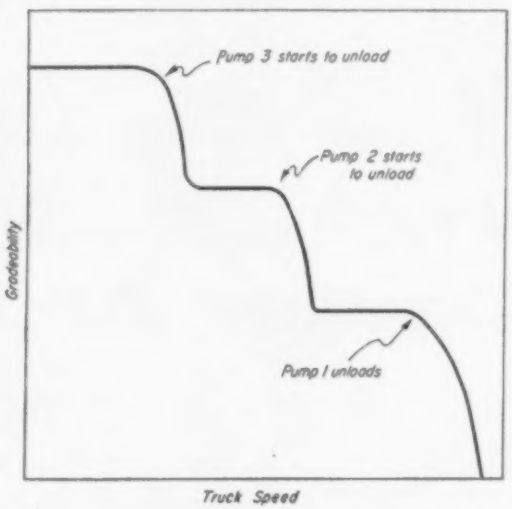


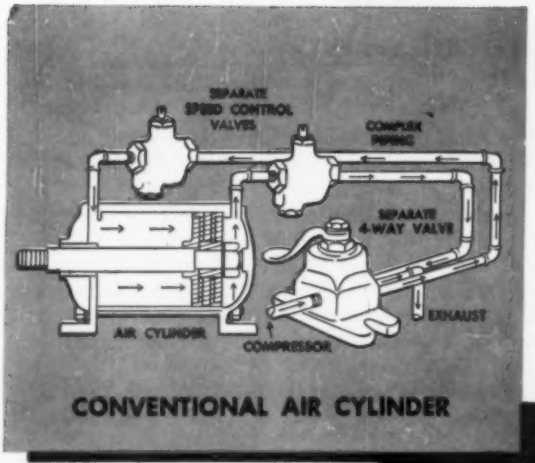
FIG. 3. Gradeability vs truck speed drops in steps as each of two pumps unload and the delivery from the third pump finally dumps off the system relief valve.

Figure 3 plots gradeability versus truck speed for this hydrostatic drive at full accelerator position.

MOTION CONTROL

Creep and Inch—The operator, through a foot pedal has a range of control either side of neutral position of the valve plunger. Metering of oil from pump 1 to the fluid motor has the characteristics of a bleed-off circuit in which system pressure varies with load rather than being the maximum as set by the relief valve regardless of load. This results in little waste energy as well as fine control. In this phase pressure is not normally high enough to unload pumps 2 and 3 through the unloading valves. Combined volumes from these pumps returns to tank by way of the control valve.

Concluded on page 80



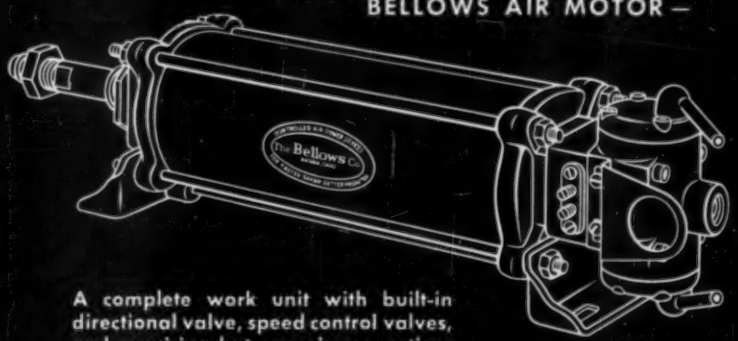
CONVENTIONAL AIR CYLINDER

ONE LOOK

and you can see the

SAVINGS

THE COMPACT, STREAMLINED BELLOWS AIR MOTOR—



A complete work unit with built-in directional valve, speed control valves, and requiring but one air connection.

Design engineers looking for simplicity and economy in air circuit installations will find a quick answer in the two circuits sketched in this ad. One shows a conventional air circuit with separate air cylinder, separate speed control valves, separate directional valve and the piping required to install the circuit. The other shows the Bellows Air Motor—the complete air cylinder package—with directional valve and speed control valves built in, and its single air connection.

But simplification of design and installation problems is actually one of the less important advantages this compact power unit offers. The big advantages are precision control and improved performance. Response is lightning fast; action is smooth and positive. And coupled with improved performance is minimum maintenance —less time out for servicing.

The Bellows Air Motor offers you a choice of *built-in* directional valves: 8v or 110v electrical control, explosion-proof electrical control, manual control, or pilot valve control—in five bore sizes: 1", 1¾", 2½", 3⅝" and 4½", and in any stroke length.

This new four-color, 24-page bulletin gives full technical data on Bellows Air Motors.

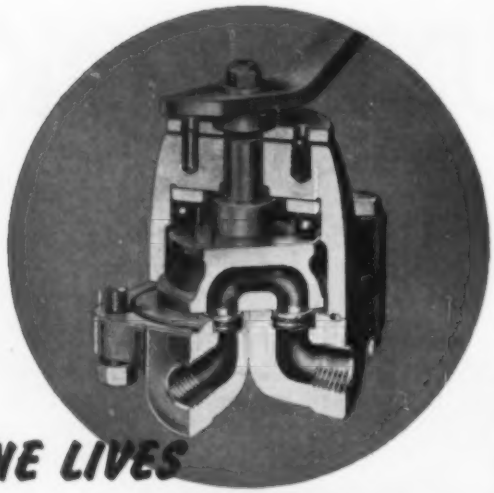
It is free on request. Ask for BM-25. Write Dept. AH1256, The Bellows Co., Akron 9, Ohio. In Canada, Bellows Pneumatic Devices of Canada, Ltd., Toronto.

The Bellows Co.

AKRON 9, OHIO

1379A

FIELD ENGINEER OFFICES IN EVERY INDUSTRIAL AREA IN THE UNITED STATES AND CANADA



NINE LIVES

OF UNINTERRUPTED SERVICE

(and no loss of sealing qualities)

IN MANUAL "SHEAR-SEAL" OIL VALVES

1500, 3000 and 6000 P.S.I.

WHERE	HOW	WHY
to improve operation of Test Equipment	Shear-Seal Valves are leakproof and *stay* leakproof for years* without service or maintenance. (No internal port to port leakage and of course no external leakage.)	Sealing qualities actually improve with use due to wear compensating lapping action of Shear-Seals
	They give quick action of full flow through round tubular flow passages	No spools or poppets obstructing flow
to provide unmatched control of oil hydraulic cylinders, presses and motors	Excellent throttling	Smooth action to any degree of flow without fighting the fluid pressure
	Quick opening & closing with surge dampening action	A quarter turn of the handle opens full round flow passages without surges caused by slamming spools or poppets
	Simplified Maintenance	By removing four bolts and without touching the plumbing all valve parts are easily accessible for replacement or service (seldom needed)

* Over three million cycles, without signs of efficiency loss, were clocked for 4-Way valves on a machine making high pressure impulse tests of aircraft hose. Another group of 24 Dual pressure valves has been operating since 1951 for 22 hours a day, five days a week, on presses making rubber casters and wheels and they are still sealing tight with practically no maintenance.

We'll be glad to refer to you similar examples in your own vicinity. To get complete data on Shut-off, 4-Way and Dual pressure Valves for oil pressures to 1500, 3000 and 6000 P.S.I. ask for bulletins 0-5 and 5-DP.

BARKSDALE VALVES

5125 Alcoa Avenue, Los Angeles 58, California

DRIVE DEVELOPMENT

Concluded from page 78

Operation of the hoist or tilt doesn't affect the drive since pump 2, which supplies the hoist, is not being used for the drive during this phase.

Acceleration—Resisting torque is highest when accelerating from a standing start. Movement of the valve plunger starts motion almost immediately. The motion of the valve plunger through the inching and creeping range gives a fraction of a second time delay to allow system pressure to build up and unload pumps 2 and 3.

Traveling—Action of the hydrostatic transmission during travel is automatic, since oil delivery from the pumps to the motor depends on resisting torque. With all pumps supplying the motor, the drive is in high speed, low torque operation. Encountering a grade which requires more than one-third maximum torque causes pump 3 to unload putting the drive in intermediate speed. A steep grade requiring more than two-thirds maximum torque puts the drive in low speed by also unloading pump 2.

Truck Accelerator Control—Pump delivery up to maximum rated volume is varied by truck engine drive speed. Since fluid motor speed depends on oil delivery, the operator can govern speed in each speed range with the accelerator. If the truck is traveling near maximum speed and the accelerator is suddenly released, engine speed decreases rapidly and the pumps don't produce enough volume to supply the motor. The motor now tends to act like a pump and draws oil from the reservoir through a replenishing check valve so that no starving results. Reversal is controlled by the valve treadle. A relief valve on the discharge side of the motor will brake the truck to a stop. Response is fast. The truck can be rocked back and forth when necessary.

This drive, developed to meet the requirements of a fork lift truck, has opened a new area of application for hydrostatic power and control. ▼▼▼

FLUID MOTOR IN DRIVE WHEELS

Concluded from page 62

when driving the tractor, even at a speed as low as one tenth mph. As long as the engine is running, brakes are not required so that the operator has no need to perform two operations when stopping, even with a load behind.

Experiments show that there is no difficulty in obtaining an overall motor efficiency of over 85%, at a speed corresponding to 3 mph, over a range of pressure from 400 to 2000 psi. A peak efficiency of not less than 90% is not difficult to obtain; a value has been recorded of 94.2% at 1000 and 1200 psi. However, this was with an oil that would probably be a trifle heavy for use with a high speed pump such as is likely to be developed for use on a tractor. The motor speed at 3 mph is

18 rpm and experiments at speeds up to 120 rpm show that the slow speed is an important factor contributing towards high efficiency.

Results at higher speeds seem to indicate that a built-in wheel motor is greatly to preferred, because of efficiency, to the use of a smaller higher speed motor with a final gear reduction to the driving wheel; but it must be remembered that the wheel motor is not designed to run at high speed, so that a fair comparison of the two propositions cannot be made on the evidence so far available. The most important factors influencing the performance of the wheel motor appear to be: the material of the valve face, the oil used, the temperature of the oil and the speed of the motor. Other variables include the piston clearance and, affecting this, the desirable range of operating pressures.

Much work remains to be done to convert this experimental tractor into an practical machine for the farm. This prototype shows a good potential for application of hydrostatic drives. ▼▼▼

SERVO SPEED CONTROL

Concluded from page 66

livers about 3/8 gpm which is drained off through the needle valve. With this delivery the pump maintains the pressure required to maintain itself at near-zero delivery.

The 5000-psi pump is driven by a 40-hp motor. The 35-gpm unit is installed with an 80-gal reservoir, and no heat exchangers are used. To provide cooling with the relatively small reservoir, oil draining from the motors is circulated through the pump.

Under the rough coal mine service, one-year service from the pump is considered very good. However maintenance is minimized because only the pump rotating group consisting of the piston shoes and cylinder barrel need to be replaced. The port plate and creep plate can be re-lapped.

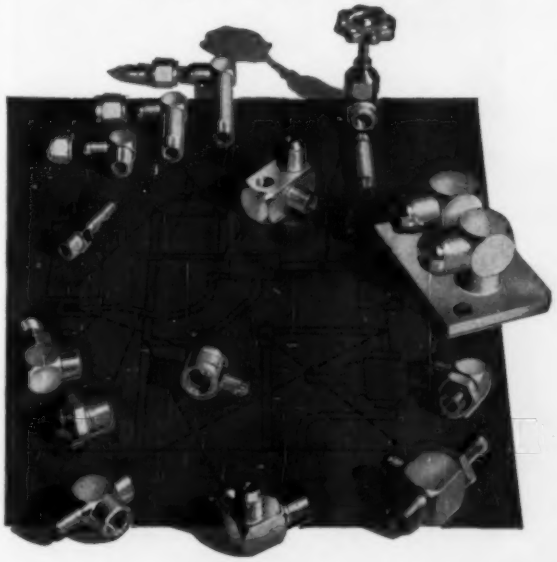
To eliminate shock on the fluid motors, a small spring-loaded accumulator is installed with each fluid motor. These are connected with a shuttle valve, so that they are effective regardless of the direction of rotation of the motors. The two fluid motors each have a displacement of 4.07 in^3/rev and produce a torque of 64.7 in-lb/100 psi. Each motor drives one of the crawler tracks through a gear-driven sprocket and chain.

In addition to the crawler track drive system, the hydraulic system also raises and lowers the rotary coal cutters, and actuates leveling jacks for the machine. Two special telescoping cylinders are installed for raising timbers, and a stabilizer shoe at the rear of the machine is actuated by a cylinder. The conveyor motions including swing, take-up, raise, and lower are also controlled by cylinders. The servo speed control system is applied to these functions as well as to the crawler drive system. For instance the cutter boom elevating jacks allow the cutter to feed down into the coal very slowly, and also permit fast reverse for lifting the cutter boom from the floor to the roof. ▼▼▼

Connect up with L and L

The Complete Line of Steel Fluid Power Couplings

JIC Flare Tube — Pipe Threaded
Flare Tube — Straight Thread "O" Ring
Flange Mounted — "O" Ring Seal



A—JIC Flare Tube Fittings
B—Manifold Fitting
C—Needle Valve
D—Pipe Nipple
E—Flange Manifold
F—Straight Thread, "O" Ring Seal Fitting
G—Ball Check Valve
H—Lateral Outlet Fitting
I—Universal Elbow
J—Dryseal Pipe Fitting
K—Hex Reducing Bushing
L—Swivel Elbow
M—Barbed Hose Stem

You can depend on L & L's quality, availability, and selection of steel couplings for piping all industrial hydraulic circuits.

Distributors in principal cities
Write for catalog No. 53

L and L MANUFACTURING COMPANY

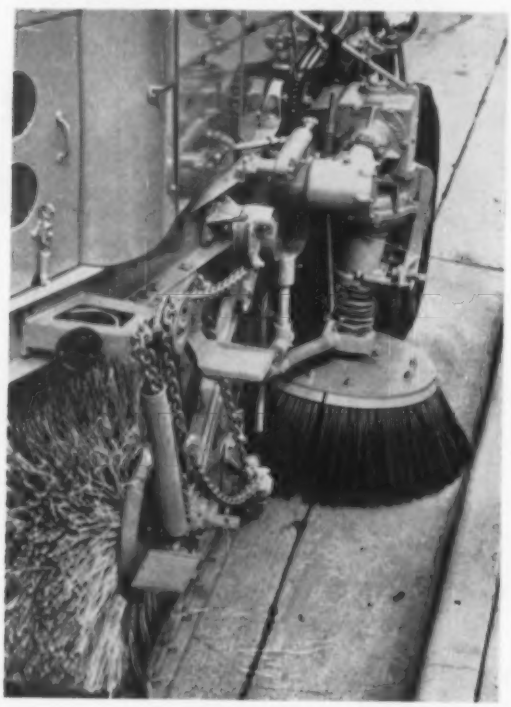
Circle 59 on Reader Service Card

SIMPLICITY OF DESIGN with hydraulics permitted streamlining. All operating parts are protected against dirt and weather.

Hydraulics was used extensively in designing this new model street cleaner and the result was simplified design, greater efficiency, easier operation and anticipated longer life with less maintenance.

NEW **GEAR TYPE FLUID MOTOR** operating through bevel and reduction gears drives side broom "floated" by the hydraulic cylinder.

OLD **OLD STYLE DRIVE** had many moving parts. Mechanism was exposed and constant adjustment of broom level was necessary.



NEW BROOM SWEEPS CLEAN

FACED with the necessity of improving the design and performance of their sweeper, Elgin Corporation engineers turned to hydraulics for assistance. They successfully improved performance and efficiency of the unit and, due to simplification possible with hydraulic systems, added considerable eye-appeal.

The smooth operation of hydraulic cylinders has replaced every function previously performed by mechanical means. The main broom is still chain-driven, but the clutch is operated hydraulically, permitting the operator to shift gears without loss of sweeping power.

Maintaining a constant sweeping pressure on the streets and gutters was formerly a problem. The

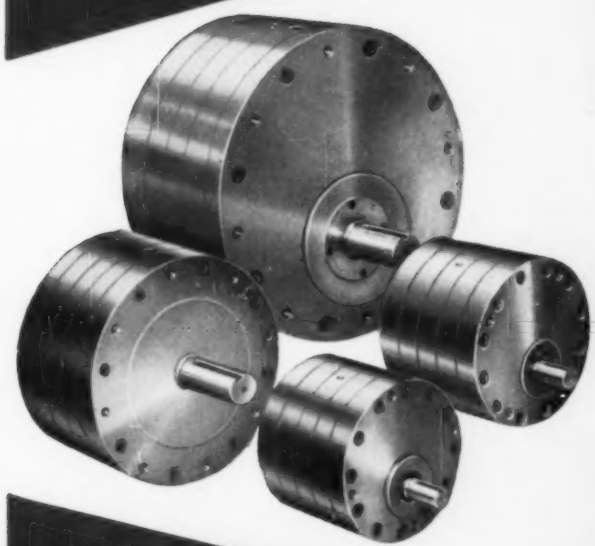
Hydraulic Data Courtesy New York Air Brake Co.

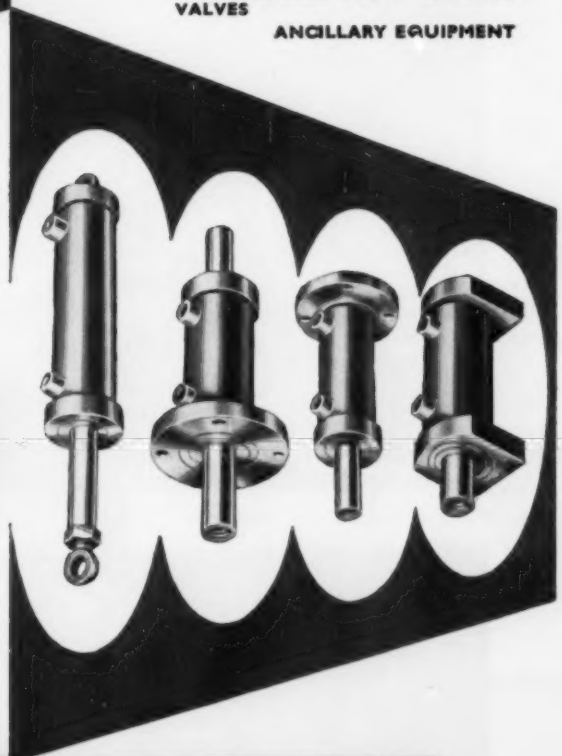
QUALITY . . . in Hydraulic Power Transmission

Our sole business is the design, manufacture and installation of hydraulic power transmissions. With a first-class knowledge of our subject and a fine range of standard equipment we guarantee quality in all our work.

Put us to the test. Send along details of your own hydraulic headache – we'll prescribe a lasting cure!

HYDRAULIC PUMPS AND MOTORS
fractional to 300 h.p. 2000 p.s.i.
DOUBLE-ACTING CYLINDERS
Bores up to 6". Strokes to application
PRESSURE AND FLOW CONTROL VALVES
ANCILLARY EQUIPMENT





INSTALLATION AND PERFORMANCE DATA ON STANDARD UNITS AVAILABLE ON REQUEST

THE RECOGNISED AUTHORITY ON HYDRAULIC POWER TRANSMISSION

Keelavite hydraulics

KEELAVITE ROTARY PUMPS AND MOTORS LTD.
ALLESLEY · COVENTRY
Telephone: Meriden 441

Canadian Agent: JOHN SPOTTON CO. LTD. 21 CARSON ST. TORONTO 14, ONTARIO

Circle 55 on Reader Service Card

NEW BROOM SWEEPS CLEAN

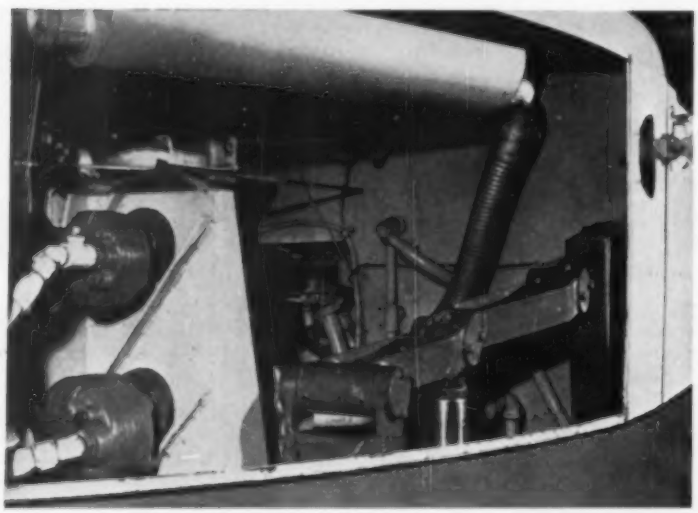
operator had to stop and handle two levers to adjust the broom height. Now both the main broom and the side or gutter broom are hydraulically floated and constant sweeping pressure is maintained regardless of surface irregularities. One lever controls the rise and fall of the main broom, operates the conveyor, and activates the automatic control of the conveyor belt.

The mechanical driving elements in the side broom mechanism are protected by the relief valve from damage if jammed against a curb or obstruction. Snubbing action of the hydraulic chambers saves wear on the brooms by eliminating broom bounce, which formerly caused rapid uneven wear.

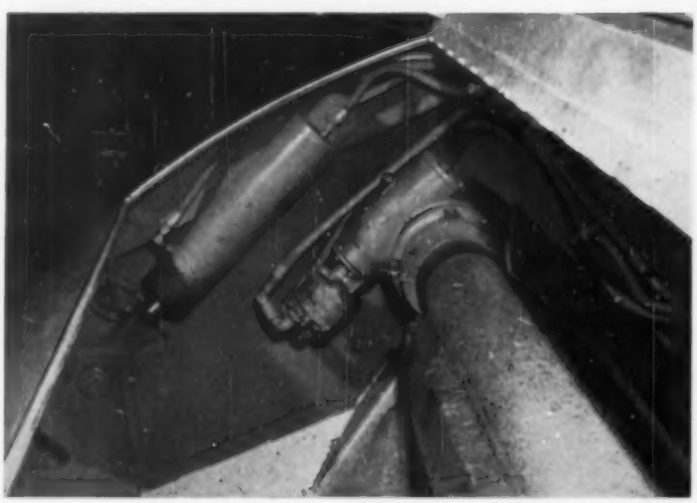
Even the dirt load is handled more efficiently in the new unit. A double acting hydraulic cylinder opens and closes the hopper. The hopper door remains in position and when the sweeper pulls away the dirt is not spread around as it was with the previous gravity dump system.

Two hydraulic circuits are used, operating at a maximum pressure of 1000 psi. Normal operating pressure for the conveyor drive circuit is 600 psi, with 400 psi used for driving the conveyor and 200 psi for floating the main broom. The sidebroom operates on 400 psi.

The use of hydraulic equipment has simplified manufacture and trimmed production costs. At the same time, required maintenance has been reduced, and all operating parts are protected against the corroding efeftcs of dirt and weather. ▼▼▼

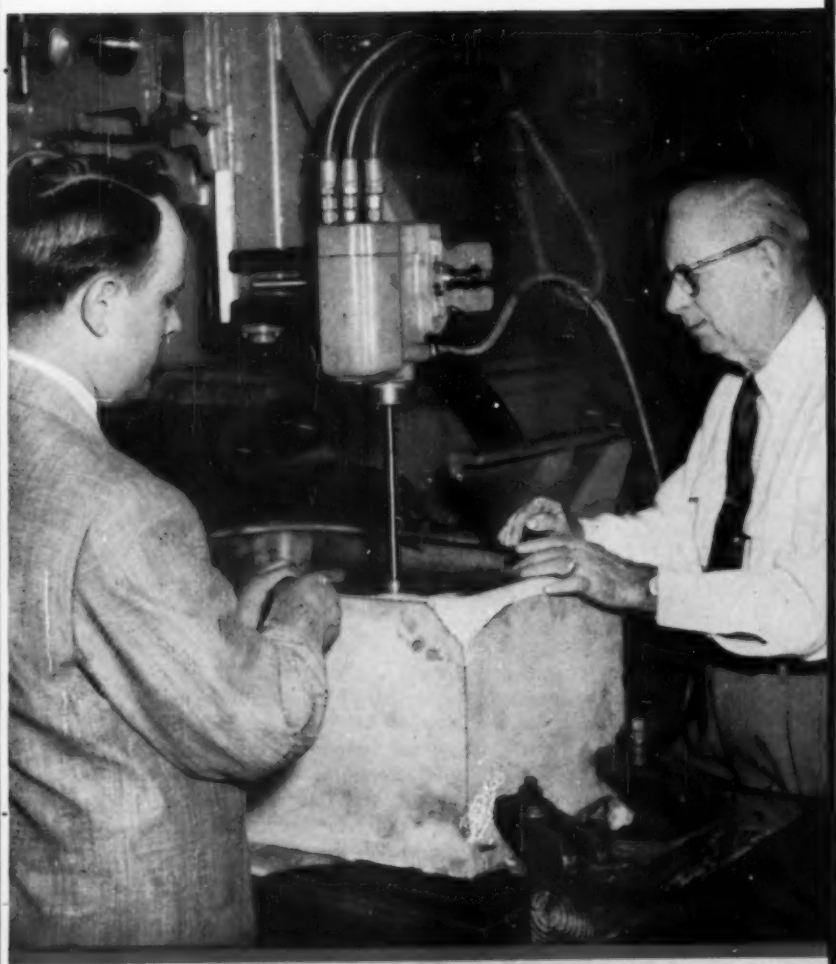


PUMPS SUPPLYING HYDRAULIC power are direct-driven by the engine independent of main vehicle drive.



CONVEYOR BELT is driven by fluid motor through worm and reduction gears. Belt is also hydraulically centered. Double acting hydraulic cylinder opens and closes the hopper.

STANOIL *Industrial Oil tough performer in delicate operation*



A. T. Wallace (right), President of Wallace Tool and Die Company, and Standard Oil lubrication specialist, H. A. Peterson, check sensitivity of new Cincinnati Hydro-Tel Milling Machine which uses STANOIL as hydraulic medium. Howard Peterson has been providing technical service to customers since joining Standard Oil. He is a graduate of General Motors Institute. Howard's customers find this experience pays off for them.

Delicate operations with metal requiring almost a surgeon's skill are every day stuff to Wallace Tool and Die Company, Indianapolis. Recently, they purchased a Cincinnati Hydro-Tel Milling Machine for their highest precision work. They selected STANOIL Industrial Oil for the hydraulic medium. The reason for choosing STANOIL: they wanted a hydraulic fluid that could deliver high performance. They wanted a clean hydraulic system, free of deposits that might clog filters and interrupt operations. They wanted smooth operation without pump chatter and without foam. They got these with STANOIL.

How did Wallace Tool and Die come to choose STANOIL? The answer is not hard to find. They had used STANOIL for hydraulic systems throughout their plant for many years. It has given them the results they wanted so it was natural to pick STANOIL for their new Cincinnati machine.

With STANOIL the machine performs the delicate operation of contour tracing with only 3½ ounces of pressure needed to control the milling cutters. STANOIL gives them smooth, steady, uninterrupted performance.

STANOIL can serve you. In the Midwest a lubrication specialist at your nearby Standard Oil office will be glad to show you. Call him. Or contact Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD

STANDARD OIL COMPANY (Indiana)

Ever think of reproducing your product to 1/4 scale as a display model? Here's how one company duplicated hydraulic actions of its front-end loader by using miniature cylinders and a new reversible pump unit.

MODELING WITH HYDRAULICS

• By W. H. Chaffee and C. Markle

USING a recently developed, compact pump unit, designers at Model Builders, Inc., Chicago have developed a miniature display model which exactly duplicates all hydraulic functions of the full-size Hough front-end loader.

The 1/4-scale model was required to demonstrate action of the bucket and associated linkage, and for realism these were to be actuated hydraulically. The tilt and lift cylinders had to be to scale, however the full-size hydraulic system did not have to be reproduced to scale. Obviously the problems of producing bucket motions in a scale model under no-load conditions have little in common with those of powering the full size unit, and the hydraulic systems have little similarity.

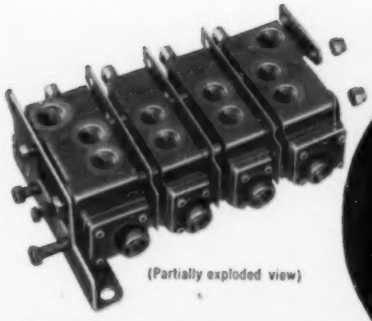
Two modes of operation were required: automatic and manual. In automatic operation the sequence is:

1. Bucket lowered in scoop position. Lift cylinders fully retracted, tilt cylinders partially extended.
2. Bucket rolls back to carry position. Tilt cylinders fully retracted.
3. Bucket rises to full height. Lift cylinders fully extended.
4. Bucket rolls forward to dump position. Tilt cylinders fully extended.
5. Bucket rolls back to carry position. Tilt cylinders fully retracted.
6. Bucket lowers to full down position. Lift cylinders fully retracted.
7. Bucket rolls forward to scoop position. Tilt cylinders partially extended.

In manual operation all the functions of the automatic cycle are controlled by four momentary pushbuttons which control the cylinders. Each set of tilt cylinders and lift cylinders is supplied from a separate pump unit consisting of reversible electric motor, pump and coupling, and integral reservoir. The motor and pump run only while the corresponding switch is depressed. Two switches control the direction of rotation of each motor and pump and consequently the direction of cylinder travel. This method of reversing the cylinders by reversing the direction of current flow in the series connected, a-c motor armature simplifies the hydraulic circuit and permits a very compact arrangement in the model base.

The cylinders of each set are connected in parallel to the pump. Because the load on the cylinders is small, and they are driven to the full extent of their travel each half cycle in automatic operation, the cylinders maintain reasonable synchronism.

W. H. CHAFFEE, *President, Model Builders, Inc., Chicago, Ill.* C. MARKLE, *Sales Engineer, Oil-Dyne, Inc., Chicago, Ill.*

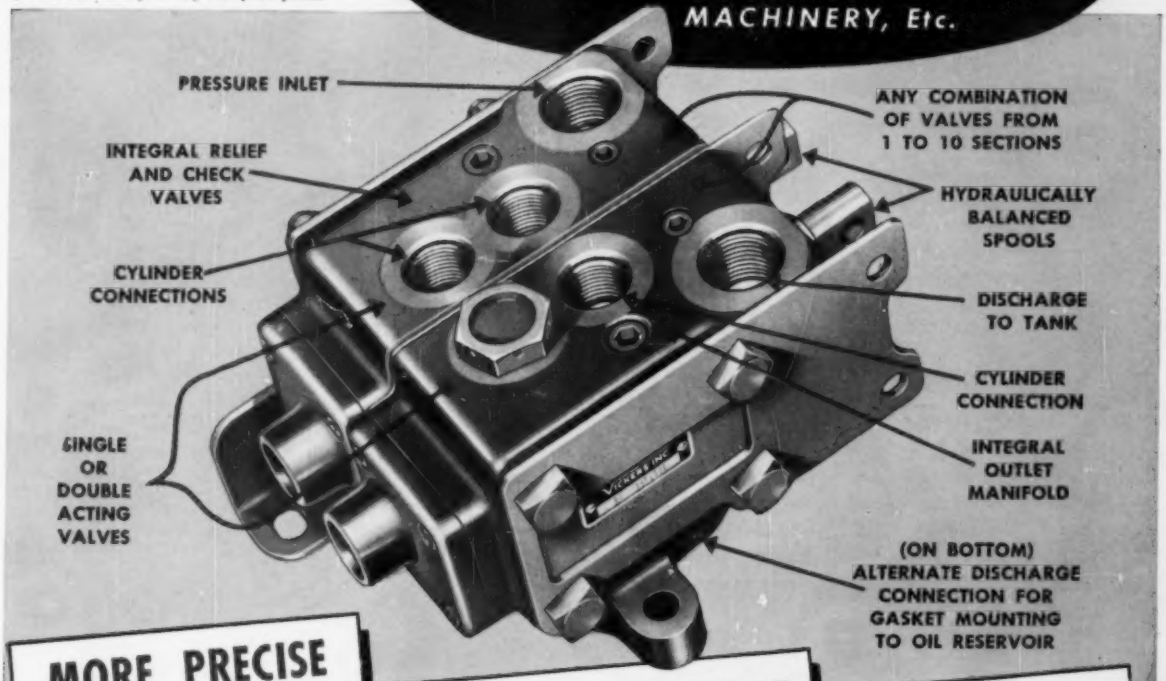


(Partially exploded view)

"U" ring seals between valve sections seal with pressure to form positively leak-proof joints.

Series CM11 VICKERS® MULTIPLE UNIT VALVES

For MATERIALS HANDLING EQUIPMENT, FARM TRACTORS, BUCKET LOADERS, CONSTRUCTION and MINING MACHINERY, Etc.


PRESSURE INLET
INTEGRAL RELIEF AND CHECK VALVES
CYLINDER CONNECTIONS
SINGLE OR DOUBLE ACTING VALVES
ANY COMBINATION OF VALVES FROM 1 TO 10 SECTIONS
HYDRAULICALLY BALANCED SPOOLS
DISCHARGE TO TANK
CYLINDER CONNECTION
INTEGRAL OUTLET MANIFOLD
(ON BOTTOM) ALTERNATE DISCHARGE CONNECTION FOR GASKET MOUNTING TO OIL RESERVOIR

MORE PRECISE CONTROL
Improved Metering Characteristics

REQUIRES LESS SPACE
New Combination Operating-Valve and End-Plate Sections

LOWER COST
Simplified Design and Construction

This is a more compact and versatile design of valve. End sections combine in one casting the inlet or outlet manifold plate together with any operating-valve section. Inlet section also contains relief valve. Individual outlet plates available for single unit valves. Single- and double-operating valve sections can be added between end sections as needed. Valve can be adapted for tandem (series) operation. Single-acting valves available for either direction of lever shift.

Other features include protection of pump from reverse flow during shifting . . . three point mounting for more simple installation . . . cylinder connections with ¾-16 N.F.-2 straight threads (AND 10050 type) help insure leak-proof connections . . . optional outlet ports in end section so valve can be gasket mounted to the oil reservoir or pipe connected. Designed for use with Vickers Series V-200 Vane Pumps (up to 11 gpm), the CM11 Valve can be used up to 2000 psi working pressure. For further information write for Catalog No. M5101-A.

7496

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
ADMINISTRATIVE and ENGINEERING CENTER
Department 1474 • Detroit 32, Michigan
Application Engineering Offices: • ATLANTA • CHICAGO CINCINNATI • CLEVELAND • DETROIT • HOUSTON • LOS ANGELES AREA (El Segundo) • MINNEAPOLIS • NEW YORK AREA (Summit, N.J.) • PHILADELPHIA AREA (Media) • PITTSBURGH AREA (Mt. Lebanon) • PORTLAND, ORE. • ROCHESTER • ROCKFORD • SAN FRANCISCO AREA (Berkeley) • SEATTLE • ST. LOUIS • TULSA WASHINGTON • WORCESTER
IN CANADA: Vickers-Sperry of Canada, Ltd., Toronto

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

Circle 111 on Reader Service Card

PUMP CAPACITY

Before pump capacity could be determined, the bucket speed had to be fixed. A time of 6 seconds was selected for the bucket to rise to full height, because this part of the cycle requires the greatest oil flow. The lift cylinders have a 1-inch bore and 3½-inch stroke. Computing the time for the cycle exclusive of pauses and flow losses gives about 19 seconds. The tilt cylinders have a ¾-inch bore and a 2½-inch stroke. All cylinders have ⅜-inch shafts.

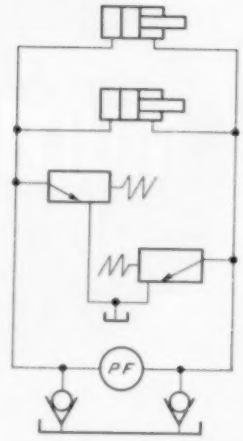
It was decided to use a pump unit which delivers 60 in^3/min with a 30-second automatic cycle time including idle time between actions.

ELECTRICAL CONTROL

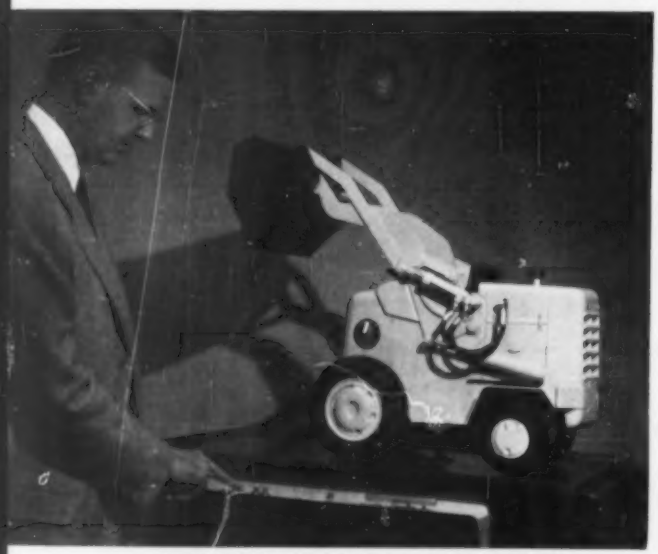
The electrical control for each pump motor unit consists essentially of a 4-pole transfer switch for switching between automatic and manual operation, two limit switches for control of motor rotation during automatic operation, and two momentary pushbutton switches for control of motor rotation in manual operation.

The circuit is supplied from a 60-cycle, 110-volt source. The limit switches are actuated by a cam shaft driven by a timer motor. The cams are adjusted to actuate the limit switches for the proper sequence of operations.

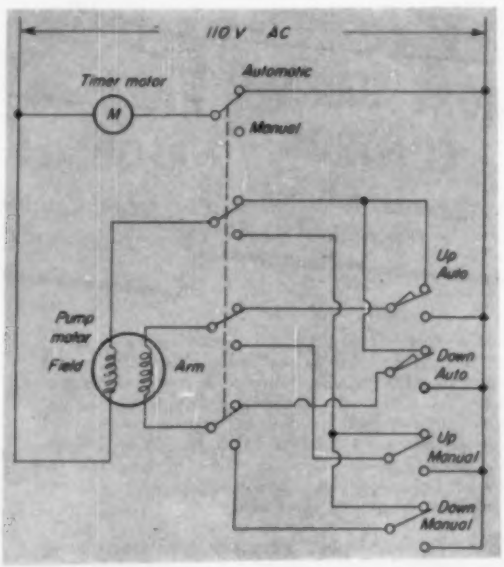
Inherent in the electrical system is its ability to switch to automatic operation regardless of the position of the bucket. It is able to do this because the mechanism cannot accept an impossible order from the timer. For instance, at the time of switching to automatic, if the bucket is fully raised and rolled back to the carry position, suppose the timer starts out by ordering action 2 above. The tilt pump tries to roll the bucket back but the bucket is already all the way back and the hydraulic oil merely flows through the relief valve. The timer then signals for the bucket to be raised (action 3 above) but the bucket is already completely raised and the pump is again unloaded through a relief valve. The bucket is now where it should be to start action 4 and the unit progresses in the automatic cycle. In a similar manner, essentially the same thing happens for any combination of bucket position and timer position at the time of switching to automatic operation. ▼▼▼



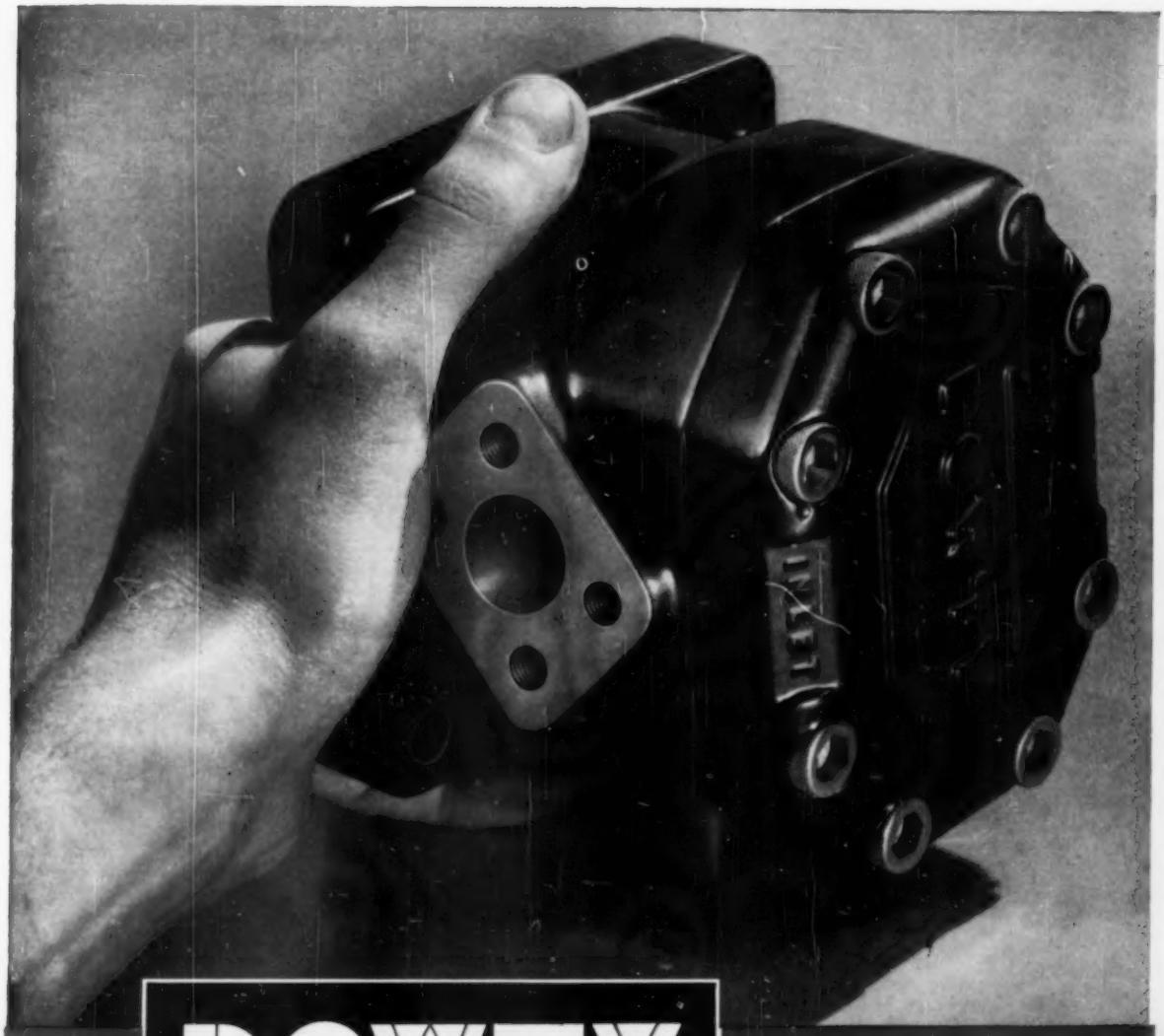
TWO LIFT CYLINDERS and two tilt cylinders are connected in parallel and supplied by separate pump units which incorporate reversing motor, pump and coupling, and reservoir. Relief valves are mounted on separate manifold and set at 250 psi.



AUTOMATIC OR MANUAL OPERATION is selected by the 4-pole transfer switch. In automatic operation, limit switches control direction of current flow through armature and direction of motor rotation. In manual operation current flow is controlled by momentary pushbutton switches.



HYDRAULIC ACTIONS of "real life" unit are duplicated in this model. The two lift cylinders and two tilt cylinders are extended and retracted by pushing the switches at left. Automatic operation is initiated by operating 4-gang switch at right.



DOWTY

hydraulic

PUMPS & MOTORS

Deliveries up to 50 g.p.m. • Outputs up to 40 horse power
Volumetric efficiencies up to 94% • Overall efficiencies up to 75%
LOW COST • HIGH PERFORMANCE • SIMPLE CONSTRUCTION

Literature available on request

DOWTY HYDRAULIC UNITS LIMITED • ASHCHURCH • GLOS • ENGLAND
DOWTY CORPORATION, 25 BEAVER STREET, NEW YORK, 4 DOWTY EQUIPMENT OF CANADA LTD. • AJAX • ONTARIO
Members of the DOWTY Group

Aviation Section

hydraulics • pneumatics

EDITORIAL ADVISORY BOARD

WAYNE S. BOALS *Hughes Aircraft Company* • **HAROLD E. WELLS** *Bendix Aviation Corp.* • **H. G. CONWAY** *Short Bros. & Harland, Ltd.* • **RALPH E. MIDDLETON** *Lockheed Aircraft Corp.* • **HOWARD FIELD, JR.** *Consolidated Vultee Aircraft Corp.* • **FRANK MITTELL** *North American Aviation* • **W. F. TALBOT** *Northrop Aircraft, Inc.* • **FRED H. POLLARD** *Republic Aviation Corp.* • **PHILIP MUSA** *Grumman Aircraft Engineering Corp.* • **KENNETH W. DUBOIS** *Douglas Aircraft Company*

Three papers presented at the SAE National Aeronautic Meeting held early in October include ideas of interest to the designer of fluid power systems. Here are abstracts of these papers.

SYNTHESIS OF AIRCRAFT HYDRAULIC SERVOS

• By George R. Keller and Elliott R. Buxton

ADVANTAGES of hydraulic and electro-hydraulic designs are being exploited by aircraft control equipment designers to satisfy stringent control surface servo system requirements imposed by today's high speed aircraft and missiles. Hydraulic systems offer attractive features including high torque capabilities with minimum weight, high force to inertia ratios, high positioning resolution, excellent irreversability, extremely high power gain in converting electrical signals to mechanical motion, long life with high reliability and ability to withstand severe environmental conditions.

• **Synthesis and Design**—Two major phases are involved; the systems synthesis and the components phases. Primary concern during first phase is establishment of suitable overall servo parameters for component design and test phase.

• **Servo Configuration**—Control surface servo represents a subsystem of the flight control system and must be carefully integrated into the major system for optimum results. Figure 1 illustrates a standard position servo, which is the simplest form of electro-hydraulic control surface servo. Many applications involve selection of both position and rate sensitive pick-off instruments. Utilizing a combination of position and rate information may re-

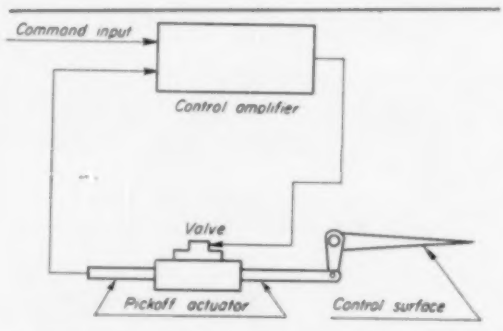


FIG. 1 Standard position servo used as simple control surface servo.

GEORGE R. KELLER *and* ELLIOT R. BUXTON, *North American Aviation, Inc.*

for these critical functions:

actuation and control of
wing flaps, landing gear,
tail skid shock struts,
locking units,
compartment doors,
pressurized
reservoirs,
self-displacing
accumulators

. . . and others equally tough

Specify

WEATHERHEAD

PRECISION HYDRAULIC

CYLINDERS

Shown here are major types of hydraulic cylinders, designed and precision-fabricated by Weatherhead to strict specifications for leading manufacturers of military, commercial and civilian aircraft. No matter how "out-of-the-ordinary" your cylinder requirements may seem, look to Weatherhead . . . inquiries are invited.

THE WEATHERHEAD COMPANY
Aviation Division
300 EAST 131st STREET • CLEVELAND, OHIO
West Coast: 1736 STANDARD AVE., GLENDALE, CALIF.
Plants at CLEVELAND and ANTWERP, OHIO • GLENDALE, CALIF. • ST. THOMAS, ONTARIO, CANADA

sult in increased overall performance for installations requiring the utmost in dynamic performance. In the preliminary analysis phase the engineer must carefully consider the estimated complexity of the servo system and justify any added complexity.

• **Servo Dynamic Requirements**—Many factors influence selection of servo performance characteristics including size of vehicle, altitude and Mach No. capabilities, degree of stability or instability and vehicle's mission. Ability of servo system to reject noise and spurious input signals can be used to advantage. Aircraft servo systems must function properly when there is a large overlap of primary information signal frequencies and spurious or noise signal frequencies.

• **Analytical Tools**—In establishing overall system performance the engineer may use various analytical tools. Standard practice includes examination of the differential equations approximating the contemplated system by the frequency response methods of Nyquist, Bode and Nichols, determining actual transient and dynamic performance by means of analogue computer studies, and utilizing digital computer methods to augment or supplement calculations of servo response requirements. Usually the synthesis of the servo system actually takes place in conjunction with the full flight control system. Therefore, methods of analysis applied to the overall system are simultaneously applied to the servo subsystem.

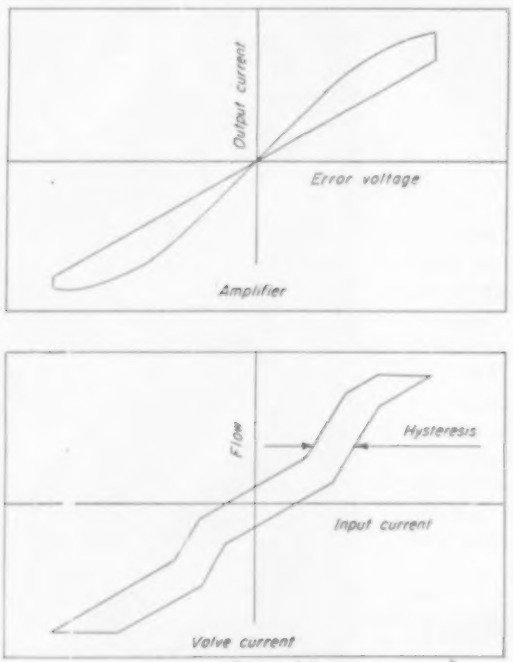


FIG. 2 Linearity, gain and hysteresis results of analysis with analogue or digital computer methods.

• **Specifying Servo Requirements**—Required static and dynamic servo characteristics must be presented in proper form for the components designer. Best practice involves establishment of several overlapping descriptive methods. Most easily represented parameters are static positioning accuracy, quasi static load carrying capacity, irreversability margin, maximum power requirement, maximum rate figure, and static linearity. These parameters should be expressed in a form compatible with standard servo test techniques. One practice is construction of a template of amplitude ratios vs frequency of output divided by input for minimum, maximum, and possibly, nominal amplitude sinusoidal input signals. Fundamental harmonic of the output is normally implied in this presentation. In addition, similar templates of input amplitude are necessary to specify the system adequately. In the case of completely linear elements throughout the servo loop, the width of the amplitude and phase templates are indicative of tolerable scale factor adjustments and time constant deviations characteristic of the system.

Analogue or digital computer methods may be useful in establishing an allowable distribution and magnitude of the various non-linear and time or temperature variant parameters. Figure 2 illustrates the results of such an analysis.

• **Integration**—Throughout the equipment synthesis and design phase following establishment of required characteristics, the design engineer must continually review the distribution of accuracy, tolerance and nonlinearities among the electrical, electronic and electro-hydraulic components. Influence of factors such as temperature, aging, and wear on important elements which establish servo parameters must be estimated and verified. The servo dynamics and electronics engineers and the component designer must work closely together and consider many factors simultaneously.

• **Fluid Supply**—An important yet frequently overlooked requirement is an adequate supply of clean oil. Supply pressure should not vary markedly with flow demand. Line pressure losses should be small and filtration adequate. Pressure fluctuations caused by pump pistons should be completely damped before the oil reaches the servos. Transmission lines should contain enough hydraulic capacitance so that surges due to sudden flow demands will be smoothed and not impose shock loads on the hydraulic system.

• **Actuator Design**—Design of the hydraulic power group and choice of transmission lines determines the flow vs pressure characteristics of the hydraulic fluid delivered to the servo. No-flow pressure can be compared to the servo stalled force re-

Continued on page 95

There's more in this barrel for you...

James E. Pratt, left, Socony Mobil engineer, obtains performance data on hydraulic system at an aluminum extrusion plant.

MORE ENGINEERS
to help you improve production and cut costs!

Specify Socony Mobil and get the services of more industrial lubrication engineers than are provided by any other oil company.

These specialists, working closely with your Mobil representative, will help you set up a plant-wide program of correct lubrication . . . advise on any lubrication problems that might arise. Their long experience and expert recommendations can improve your production and cut costs.

Socony Mobil products are also backed by *more* services for analyzing petroleum products in use . . . *more* on-the-job training of your personnel in correct product application . . . *more* approvals from machine builders . . . *more* continuous research to assure continually improved products . . . *more* practical experience—90 years!

Always specify Socony Mobil. There's *more* in every barrel for you!

SPECIFY **SOCONY MOBIL** FIRST STEP IN CUTTING COSTS

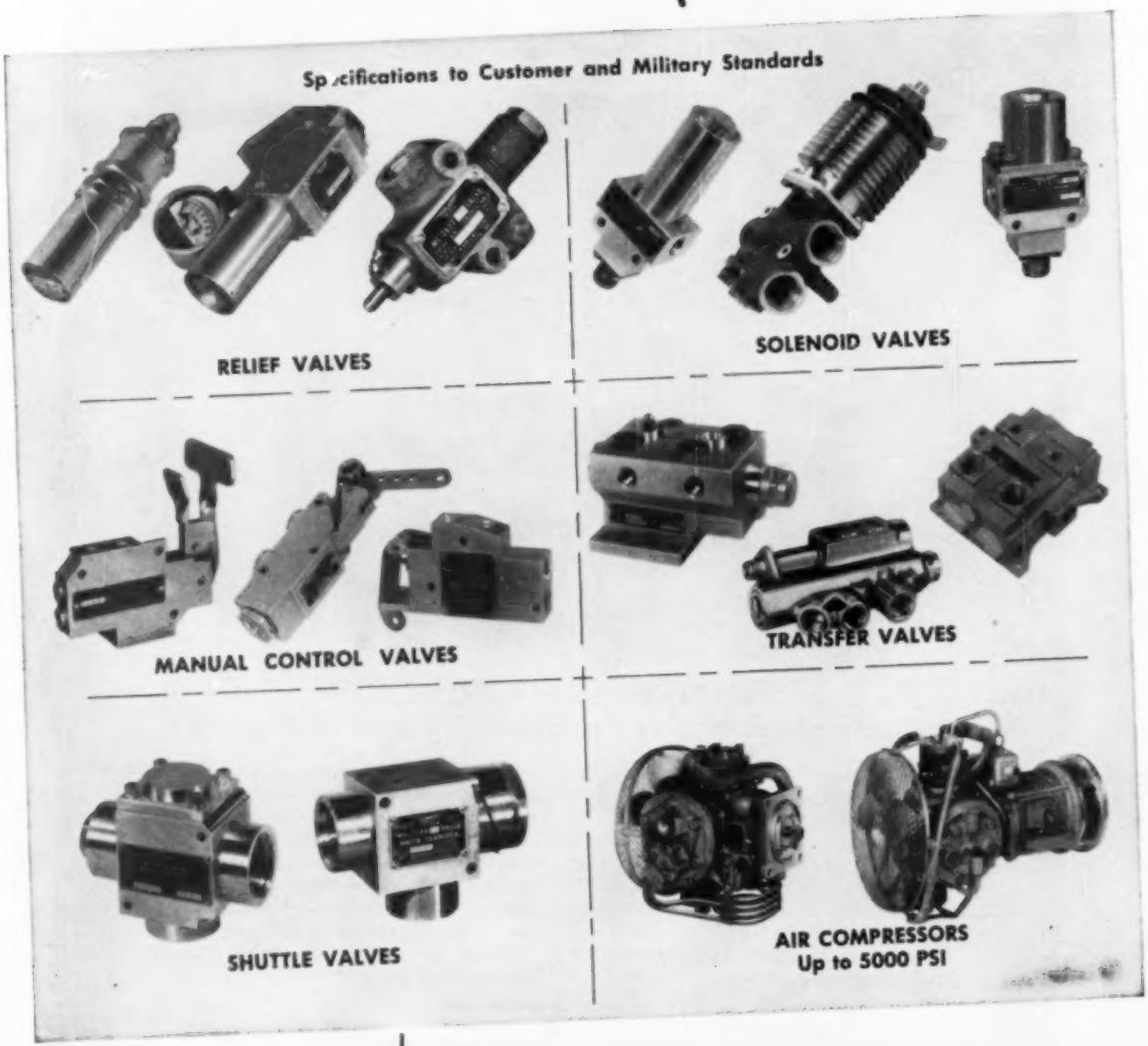
SOCONY MOBIL OIL CO., INC., and Affiliates: MAGNOLIA PETROLEUM COMPANY
GENERAL PETROLEUM CORPORATION

LUBRICANTS • FUELS • CUTTING FLUIDS • WAXES • SOLVENTS • PLASTICIZERS • PETROCHEMICALS

M.C. MANUFACTURING COMPANY

PRECISION PRODUCTS

Hydraulic and Pneumatic Components for the Aircraft Industry



Other Products

BRAKE VALVES • CONTROL VALVES
FUEL VALVES • FUEL PUMPS
DEHYDRATORS
PRESSURE REDUCING VALVES
RESTRICTOR VALVES
SPECIAL VALVES

M.C. MANUFACTURING COMPANY

118 INDIANWOOD RD., LAKE ORION, MICHIGAN

West Coast Office: 716 Wilshire Blvd., Santa Monica, Calif.

Representatives: D & O Engineering Co., P. O. Box 3107, Wichita, Kansas
L. Youngs, 7520 12th, N.E., Seattle 15, Washington
F. C. Minch, 1132 Donson Drive, Dayton 10, Ohio

FACILITIES INCLUDE COMPLETE ENGINEERING • DESIGN • MANUFACTURING • TESTING • PROCESSING • AND QUALITY CONTROL SYSTEM

Circle 64 on Reader Service Card

quirements to get a first approximation of the effective area of the actuator. Great care must be taken to determine effective spring rate of the fluid in the working portions of the servo system. It is possible to get a combination of fluid spring rate and surface inertia which is resonant in or near the bending modes of the airframe or which can be excited by gust loading of the surface. Vibrations of a surface control servo at resonance can destroy a complete airplane.

• **Servo Valves**—There are several ways of matching the size of a servo valve to the servo requirements. It is easily demonstrated that the servovalve is most efficient in supplying load horsepower when $\frac{1}{3}$ of the pressure drop in the servo occurs in the valve and the other $\frac{2}{3}$ supports the load. Many manufacturers rate 3000 psi valves at the flow corresponding to valve pressure drop of 1000 psi, for this reason.

This rule may not result in a valve choice which is economical from a space standpoint. Recourse should be taken to velocity-hinge moment curves. Use of effective actuator area allows these curves to be transformed to flow vs pressure relationships. Flow through the valve is a linear function of the square root of pressure drop across the valve. Assuming a constant supply pressure allows for calculation of available load-supporting pressure as a function of flow. This is obtained by subtracting the valve pressure drop from the supply pressure for each flow valve.

• **Servo Testing**—Loads imposed on a surface control servo consist of bearing friction, resistance of surface inertia to acceleration and wind pressure on the surface. As the effect of wind pressure is nearly proportional to the excursion of the surface from its streamline position, it closely approximates spring loading. Rate of wind-loading varies with flight altitude and Mach Number. With proper test instrumentation, dynamic transient and frequency response characteristics of the servo can be tested in a simulator over all expected flight conditions.

▼▼▼

INTEGRATED CONTROL SYSTEMS FOR AIRCRAFT

• By R. Hadekel

OPERATION of aircraft at high speeds leaves so little margin for error of any kind that a high degree of automatic control is unavoidable. This is currently true of military aircraft and will undoubtedly apply to civil airliners as their speeds increase.

Until recently the three problems—powered actuation, artificial stabilization and automatic flight control—were treated independently. However, it is obvious that they are only different aspects of the overall problem of controlling an airplane.

• **Essentials**—Automatic flight control and artificial stabilization begin with sensing instruments detecting any departure of the aircraft from the desired path and the desired state of uniform oscillation-free motion. These instruments are the essential source of information for any automatic system. The information is fed to a central control device or computor. Based on that information the computor sends out suitable signals to the actuators which operate the control surfaces.

System must be capable of accepting demand signals from the pilot as well as from the instruments-computor setup. There are three ways of providing for this:

1. Actuators accept either signals from the pilot or signals from the computor, but not both together. This is incomplete solution as it fails to give artificial stabilization while under pilot's control.

2. Actuators accept either signals from the computor only or signals from the pilot and computer together. Pilot's signals may still travel through the computor which may superimpose some stabilizing signals.

3. Computor may be arranged when required to accept signals from the pilot and reinterpret them before passing them on to the actuators. Computor interprets the pilot's signals not as demands for given motions of control surfaces but for given maneuvers of the aircraft.

• **Actuation**—An actuator for an integrated system must be controllable by a computor and must understand the computor's language which is electrical. Control valve must respond to electrical signals and must be driven by some form of torque motor. Usually the actuator must report its position

R. HADEKEL, *Engineering Manager, Sunbury, The Sperry Gyroscope Company Limited*

back to the computor. Therefore it must be fitted with some electrical position pick-off device. Open-loop control of the actuator is possible by arranging the computor to move the valve by an amount proportional to required rate of movement of control surface. This could be refined by using velocity feedback from the actuator.

Where actuators accept signals from pilot or computor, the pilot's signals can be conveyed mechanically by the usual control linkage. Mechanical error signal is derived either by using a moving cylinder arrangement or a differential lever. When the backlash device is closed the valve is directly connected to the mechanical linkage. Resisting force of the torque motor is too small to affect the pilot's feel or movements. With backlash device open, the torque motor is in full control. If the stick is held fixed at the trim position, the amount of backlash provided determines the maximum control surface movement which the auto-pilot can produce. Beyond the limit of backlash the mechanical feedback operates to reset the valve.

Another arrangement is shown in Figure 1. Mechanical linkage is attached to torque motor body. When the torque motor is locked solid at *A* and backlash at *B* is also locked out, the pilot is in control through the mechanical linkage. With *A* and *B* unlocked the torque motor is in control, but the movement it can produce is limited by backlash at *B*, as before. With *A* unlocked and *B* locked, it is possible to use the torque motor to add stabilizing or damping signals to the pilot's demand signals.

Control valve may have to handle powers upward of 20 hp. Under such conditions it is usually preferable to have a two-stage arrangement with

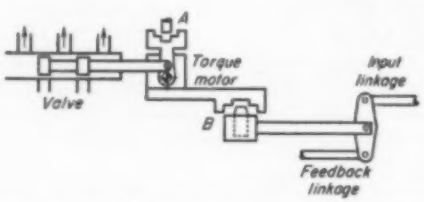


FIG. 1 Double lost motion arrangement showing mechanical linkage attached to torque motor.

the torque motor driving a pilot valve which in turn drives the main valve. In this case further solutions are possible. In Figure 2 two pilot valves are driven by a torque motor and by mechanical linkage. A solenoid valve connects the main valve to one of the pilot valves. This switches control from the torque motor to the linkage. Stick movements can also be picked off electrically and signalled to the torque motor with stabilizing signals being added in the computor. Revision to mechanical actuation may then be used only for emergency operation. This system applied to pilot valves

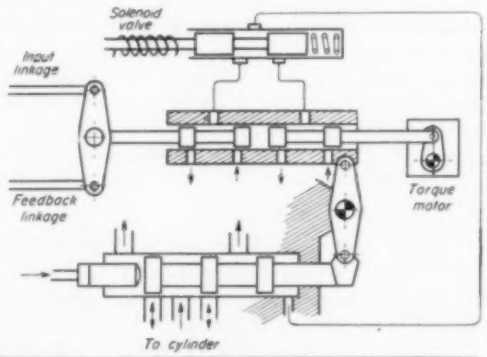


FIG. 2 Electro-mechanical control valve with two pilot valves driven by torque motor and mechanical linkage.

uses mechanical feedback from the main valve. However, the system would seem to be applicable to other types of two or three-stage valves.

• **Electrical Signalling**—Transmission of mechanical motion with rods, cables, levers, etc. is cumbersome but reliable. For electrical position signalling to achieve comparable reliability duplicate signalling must be provided, with automatic means of coping with failures. Ordinarily, the advantages of electric signalling might not be sufficient to justify the complication involved. However, the problem is different in dealing with inherently unstable aircraft. An automatic stabilization system is required to function at all times with an extremely high degree of reliability. Mechanical linkage cannot control the aircraft alone.

For such conditions the most likely solution would have the computor reinterpret the pilot's demand signals. For instance, a sideways movement of the stick may be interpreted as a demand for given rate of roll. In high speed aircraft this may require high aileron motion in one direction followed by some opposite aileron. The computor would automatically provide this. This type of control is not new. However, instead of being an added facility of the auto-pilot, this system becomes the basic means of controlling the aircraft.

All electric components involved would have to be duplicated at least. There is also the question of reliability of hydraulic components and supplies. One way to solve both problems at once is for each control surface to be driven by three actuators in parallel, as shown in Figure 3. Each unit has its own hydraulic supply, electric signalling devices, wiring, networks and certain basic instruments of its own. Any single failure would affect only one

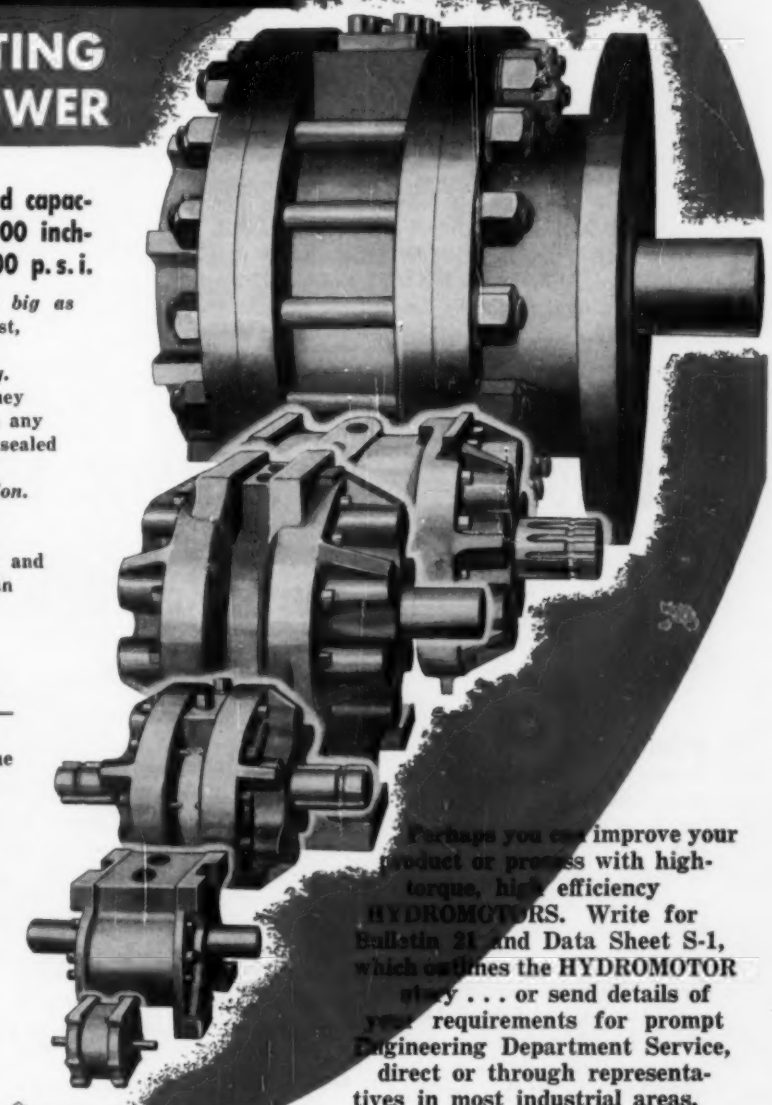
Automation with the *Hydromotor*

RECIPROCATING ROTARY POWER

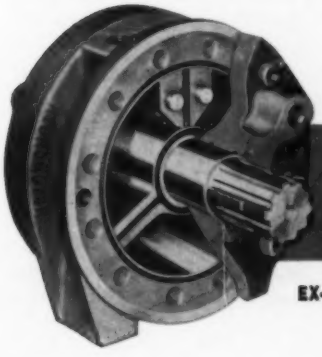
Wide choice of models and capacities from 150 to 1,000,000 inch-pounds of torque at 1000 p.s.i.

From the smallest *(only as big as your fist)* through the largest, HYDROMOTORS are *saving users time, space and money.* Compact and lightweight, they can be mounted anywhere, in any position and are completely sealed and self-contained to insure *dirt-free, trouble-free operation.* HYDROMOTORS eliminate expensive, bulky mechanical linkages, installation is fast and easy, maintenance is cut to an absolute minimum.

With HYDROMOTORS *reliable automation* can be achieved more simply. This reciprocating rotary actuator—operating with air, water or oil—develops instant full torque in either direction. Standard units travel 280° and develop 150 to 500,000 inch-pounds of torque. Double vane units—with maximum travel of 100°—approximately double the above torque values of the single vane unit IN THE SAME SIZE HOUSING. Special sizes are custom-built to individual specifications.



Perhaps you can improve your product or process with high-torque, high efficiency HYDROMOTORS. Write for Bulletin 21 and Data Sheet S-1, which outlines the HYDROMOTOR story . . . or send details of your requirements for prompt Engineering Department Service, direct or through representatives in most industrial areas.



Hydromotor DIVISION

EX-CELL-O CORPORATION • CANTON 2, OHIO

LOWERING • REVOLVING
LIFTING • PUSHING • PULLING
SWINGING • OPENING
CLOSING • CLAMPING • TURNING
INDEXING • OSCILLATING, ETC.

Circle 53 on Reader Service Card

channel. Whatever the cause of the fault, the actuator in the faulty channel would be overpowered by the other two. This type system could not stand two failures in general, but can be arranged to stand certain combinations of two failures. If any combination of two failures is to be tolerated, quadruplication would seem inevitable. There are difficulties in synchronizing three actuators—let alone four—but in some respects all-electric signaling facilitates actuator design. With electrical actuation only the valve is simpler than one for both electrical and mechanical inputs. Mechanical differentials or moving cylinder arrangements are not required. Also, there is less chance of instability due to structural feedbacks through the signalling system. ▼▼▼

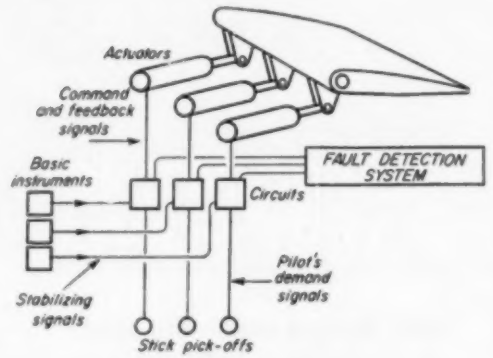


FIG. 3 Triplicated electrical signalling system for one control surface showing separate system for each actuator.

HYDRAULIC AND PNEUMATIC PROBLEMS IN HIGH PERFORMANCE AIRCRAFT

• By Ralph E. Middleton

TOMORROW'S aircraft will operate with hydraulic and pneumatic system temperatures ranging from 400 to 600 degrees F. and higher. This poses problems in selection of materials, designs of components and design of the system itself.

• **Fluids**— At high temperatures air in intimate contact causes rapid breakdown of the fluid. Air cannot be allowed in the system. Intake of fluid must be regulated while bleeding off the air. Reservoir must be safeguarded against over-pressurizing by over-filling or filling too rapidly. Failure of a relief valve in reservoir system can cause loss of the entire fluid supply overboard.

• **Pumping**—Demand is now averaging 100 to 150 hp per pump and space available has decreased about 25 percent. With the pump engine-mounted, speed is usually 6,000 to 8,000 rpm. When mounted remote from the engine the pump is usually driven by electric motor or turbine. Electric motor speeds run around 12,000 rpm and turbine speeds 25,000 rpm or higher. This requires gear reductions. Being able to run the pump at motor or turbine speeds would result in an integrated package located at remoter parts of the aircraft.

• **Power Transmission**—Horsepower in the hundreds means staggering flow rates. Specific gravity fluids for high temperatures is 25 percent higher than mineral oil fluid. This means high inertia in lines, reduced response rates, reduced transmission efficiency and high rates of heat generation. Increased flow rates will permit use of smaller lines. Reducing the margin between working pressure and maximum design pressure results in saving of space and weight.

• **Tubing**—Installation of large, rigid tubes in aircraft having limited space available is quite a problem. Routing of lines must provide for removal for servicing. Where units are closely grouped, or long straight runs without bends are involved, adjustable fittings accommodate removal of units as well as length tolerances.

A normal system may get about 3-1/2 million stress cycles in 500 hours of flying. Therefore, fatigue life designs the system. Use of manifolds to which components are bolted or screwed offers advantages in reducing space occupied, number of tube joints and tube runs, and improving serviceability.

• **Seals**—Static seals, boss seals and end cap seals can be provided

RALPH E. MIDDLETON, *Lockheed Aircraft Corporation*

Why Parker O-rings seal better and last longer!

For trouble-free leakproof sealing, you can depend on precision-molded Parker O-rings. Laboratory and service tests check every detail of the manufacturing process. Precision-molding by exclusive methods assures accurately sized O-rings. And we have molds for over 296 standard O-ring sizes!

From Parker you get exactly the *right* O-ring for your *specific* application. We invite you to prove by comparison tests how Parker O-rings seal better and last longer. Our engineering service will be glad to help you with designing problems. Mail the coupon or ask your Parker O-ring distributor for catalog.

Parker
Hydraulic and fluid system components

RUBBER PRODUCTS DIVISION
Section 521-A
The Parker Appliance Co.
17325 Euclid Ave., Cleveland 12, Ohio

☐ Please send O-ring Catalog No. 5701

NAME_____
COMPANY_____
ADDRESS_____
CITY_____ STATE_____

Circle 78 on Reader Service Card

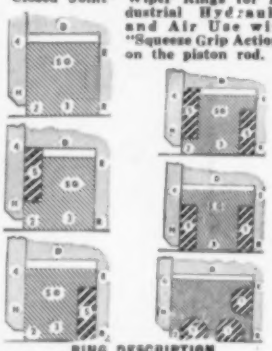
Circle 2 on Reader Service Card

Stop This Dirt Streak at the Ring Joint

with the "CJ" Closed Joint

Fall Wiper Ring

Showing 6 of the many FALL "Closed Joint" Wiper Rings for Industrial Hydraulic and Air Use with "Squeeze Grip Action" on the piston rod.



RING DESCRIPTION

SG—Indicates "Squeeze Grip."
2—Front side of ring.
3—Closed joint in in ring.
4—Flange (or plate) holds ring in cavity.
5—Rubber seal compressed in restricted area.
H—Inside dia. of flange at bevel end (see #4 above).
D—Depth of Cavity for holding ring.
E—I.D. of cavity for holding ring.
R—Ring I.D. and/or rod O.D.

FALL Industrial Wiper Rings have a "closed joint" therefore contact entire rod O.D. and remove ice, dirt and other stubborn substances adhering to rod. When needed, certain of our "rubber seal" features are added to ring to "seal out" dust, sand, etc., preventing passage AROUND ring. To "seal out" liquids we add still another rubber seal feature preventing passage THROUGH ring.

SPRING LOADED

Squeeze Grip Action Does It

—and squeeze grip is always the same because of uniform tension of spring on ring at all times.

Our engineers will gladly work with you on any wiper ring problem. Write, wire or phone us.

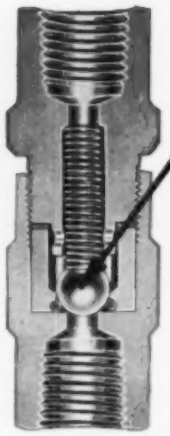
Ace Products Company,
Toledo 1, Ohio
Phone Cherry 36513

You can depend on ACE PRODUCTS . . Estab. 1935!

ALL FALL Wiper Rings are covered by patents issued or patents pending

Circle 49 on Reader Service Card

Point of No Return in HOKE



Ball Type CHECK VALVES

Hoke ball-type check valves are precision engineered for minimum flow resistance and positive reverse flow check. Synthetic rubber seats and stainless steel springs give maximum corrosion resistance and long service life. Line pressures to 3000 psi. Stock sizes, ⅛" and ¼" in stainless steel and brass. Larger sizes or other materials to your requirements. Complete information is yours for the asking.

HOKE

HOKE INCORPORATED
Fluid Control Specialists
187 S. DEAN STREET, ENGLEWOOD, N. J.

Control Gases to 10,000 P.S.I.

WITH VICTOR GAS-O-DOME REGULATORS

Gas pressure, not springs, control diaphragm motion to give you precise regulation of high-pressure gases at high or low flow rates. Can be remotely controlled if desired. Safety valve furnished on request. More than 55 stock models in the following series:

GAS-O-DOME SERIES	DELIVERY RANGE (p.s.i.)	SPECIAL FEATURES	GASES HANDLED
GD 30	0-2500	High Delivery Flow Rates. Accurate Valve Control.	Air, Argon, Helium, Hydrogen, Nitrogen, Oxygen —and others non-corrosive to bronze and stainless steel.
GD 31	0-3600		
GD 61B	0-2500	Excellent Capacity. Compact— 7 lb.— 4" x 6" x 6". —67° to +160° F. Range.	
GD 62B	0-3600		
GD 80	0-5000	Accurate Valve Control. —67° to +160° F. Range.	
GD 81	0-10000		
GD 10	0-500	Self-Relieving Pilot Regulator Control. High Flow Rates.	
SR 10	0-1000	High Pressure, Low Flow. Compact—4 lb. —2" x 6" x 6".	
SR 100	0-30 & 0-40	Corrosion Resistant.	Ammonia (wet or dry) Boron Trifluoride Chlorine (wet or dry) Hydrogen Sulfide, Hydrogen Chloride, Sulfur Dioxide—and other corrosive gases.

VICTOR'S LONG EXPERIENCE IN PIONEERING HIGH PRESSURE GAS REGULATION *is yours for the asking. For details, and complete data on Gas-O-Dome Regulators, see your VICTOR dealer or write us for catalog 341. Dealer inquiries invited.*

VICTOR EQUIPMENT COMPANY

Mfrs. of welding & cutting equipment, hardfacing rods; blasting nozzles; cobalt & tungsten castings.

844 FOLSOM ST. • SAN FRANCISCO 7 21

HIGH PERFORMANCE AIRCRAFT

Concluded

by metal O-rings or metallic gaskets. Internal seals in valves can be worked out using metal-to-metal poppet seal or lapped fits. Piston head seals can be metallic piston rings. Moving shaft seals, projecting into the atmosphere, present the most difficult problem.

• **Actuators**—Spring rate of the actuator and its feedline is of great importance. Elasticity of various fluids has been established only within limited temperature and pressure ranges. This modulus decreases at high temperatures. One way to overcome this effect is to use rotary hydraulic motors, geared to the load. Gearing and mechanical linkages can substitute for the stiffness provided by the fluid.

Packing friction is an important factor, particularly to servo actuators. Teflon is used mostly for back-up for the standard O-ring.

• **Pneumatics**—Air has the advantage of being stable within the temperature ranges being considered. It has extremely low inertia and low weight, will not burn, can store large amounts of potential energy which can be released with extreme rapidity. However, there are a number of problems involved in its use. An adequate supply must be provided with interstage cooling which increases the load on the cooling system. Sealing is difficult as the high pressure air must be sealed at low temperatures.

To secure reasonable work efficiency and low weight, flow rates become low under high load conditions. This results in larger lines being used, with loss of larger quantities of air, since each line must be filled and exhausted to the atmosphere during each operation. Consideration could be given to a system returning exhaust air to a reservoir at a lower pressure, but higher than atmospheric. Also, a pneumatic motor could be used in place of a linear actuator to provide a good expansion ratio between inlet and exhaust. ▼▼▼

HERE'S a helping hand

for your packing problems

Let our packing design specialists help you determine the right packing for each specific job. Your special needs are followed to the letter . . . and MARSH packings are built the way you need them . . . to give dependable service for a long long time.

MARSH THERMO LEATHER PACKINGS

IMPREGNATED WITH SYNTHETICS

ARE DESIGNED "RIGHT" FOR THE NEED

Quality and Dependability

Backed by ***55 Years*** *of Leadership*

CUP PACKING
A piston packing for use on cylinders and controls, low or high pressures.

U PACKING
A single-lip rod or piston packing against low to moderate high pressures.

NON-EXTRUSION OR BACK-UP WASHERS
For use with "O" rings—eliminates extruding and keeps grit and dirt away from "O" rings.

V PACKING
A multi-lip rod packing against medium or high pressures.

FLANGE PACKING
A single-lip packing against low to moderate high pressures.

CUP AND HEEL WASHER
For use against higher pressures—eliminate pinching due to too much clearance.

Engineering and Consulting Service
Ask MARSH field engineers to survey your packing needs and make recommendations

C·W·MARSH COMPANY

MAIN OFFICE AND FACTORY: MUSKEGON, MICHIGAN

SALES OFFICES: 75 East Wacker Drive, Chicago 1, Ill. — 548 South Border Road, Winchester, Mass. — 101 Park Avenue, New York 17, N. Y. — 1900 Euclid Avenue, Cleveland 15, Ohio

...AN AH STAFF REPORT....

Designers of fluid powered systems are starting to use static electric controls. Application of these new controls to the fluid power field will greatly increase during the coming year. AH's associate editor Allan Morris hopped from the NCIH meetings in Chicago to the AIEE Conference on Machine Tools in Cincinnati late in October to report their discussions in this new area of control.

AIEE MACHINE TOOL CONFERENCE

Electrical Static Controls: Advantages of static electrical control components were listed by F. L. Fisher, Allen-Bradley Co. as small size, quiet operation, and good protection against environmental effects. However many problems exist in their application such as high cost, maintenance beyond the electrician level, difficulty of changing the control system, and the low voltage operation which requires new push-button control. Fisher indicated that future electrical systems would probably be combinations of relays, semi-conductors, magnetic amplifiers, and other components.

Jack Sheets, General Electric stated that the high initial cost of tatic control is justified by their long life and low maintenance. Square D Co.'s primary product in the field of static control, P. R. Goudy explained, is a proximity limit switch with a 1-inch range. Its use is for positioning, detection, and as a counter, especially in hazardous locations.

Magnetic Amplifiers: These have become standard tools with almost unlimited life, O. M. Bundy, Clark Controller Co. explained. Comparing the present concern over static controls with that over vacuum tubes in the 30's he predicted each type of electrical component will find its best application. Speaking for the Westinghouse system, P. G. Hanna pointed out that relays have one input and many outputs, while his company's control has many inputs and one output.

System Engineered: The thinking at Doelcam Div., Minneapolis-Honeywell Regulator is to integrate design of the sensing element (proximity switch), logic element (static control) and output element (electro-hydraulic servo valve). William Rote speaking for Doeclam indicated that the largest machine tool cylinders can be controlled by an electro-hydraulic servo valve operating on 1 watt, 50 to 100 ma. Hydraulic power represents a very efficient transducer to mechanical energy, he stated.

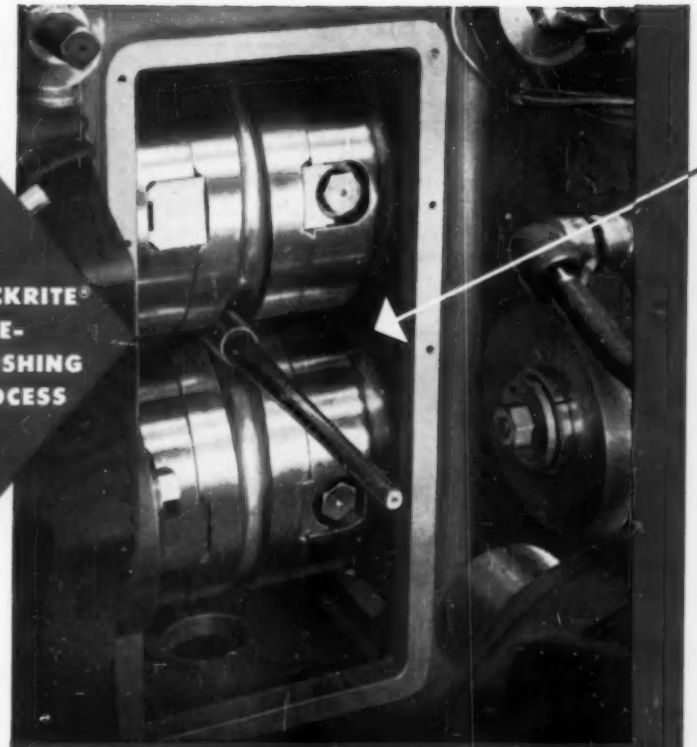
Cost of Static Controls: Much discussion centered on present high cost of static controls. This was attributed to high quality materials and workmanship, requirements for reliability, present low production, and difficult manufacturing procedures such as winding toroidal coils.

Static Control Standards: Describing the recent revision of the National Machine Tool Builders Standards, E. J. Loeffler, Warner & Swasey, said the standards for static control, and numerical control were not included because of inadequate experience with this equipment.

Why Numerical Controls? Numerically controlled machine tools are of great importance for machining extremely complex shapes. Machines with conventional controls are totally incapable of machining these shapes, and even the use of tracers present a difficult problem. These statements were made by R. H. Schuman, Warner & Swasey, giving a general view of numerical controls. "Even though the numerical controls become very complex and expensive, the gains to be realized by their use can more than justify their expense," he said.

Servo controlled Slides: Speaking of machine tools slides Schuman said that conventional slides have been developed to a very high degree, but are not well suited to servo operation. Principle factors in evaluating a servo drive are backlash, resonance, and friction. In a hydraulic servo drive such items as compressibility of oil are limiting factors.

Numerical Control and the Machine Operator: Numerically

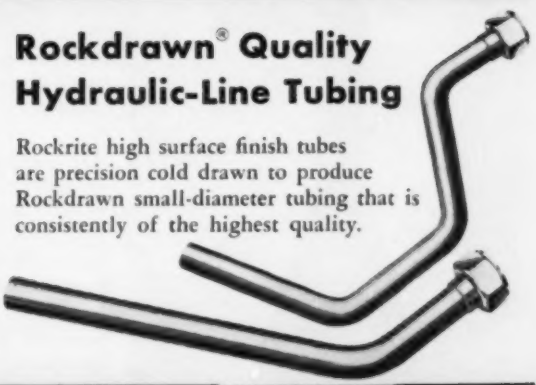


High quality begins here

This tube, leaving the Rockrite reducer, has been cold compression rolled—with great metal displacement. Result: Better structure of the metal, precision dimensions, and excellent surface finish. It is a quality tube.

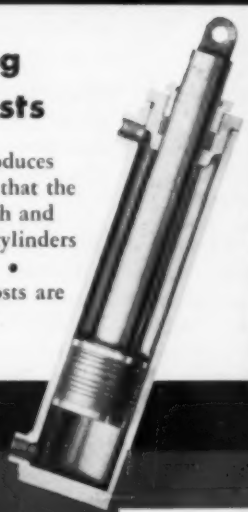
Rockdrawn® Quality Hydraulic-Line Tubing

Rockrite high surface finish tubes are precision cold drawn to produce Rockdrawn small-diameter tubing that is consistently of the highest quality.



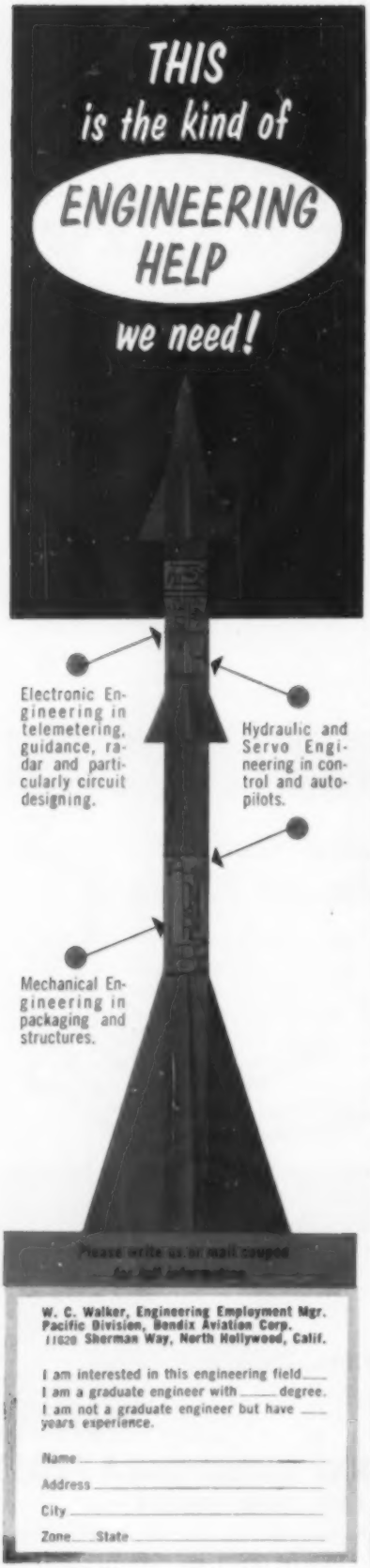
Cylinder Tubing cuts honing costs

The Rockrite process produces such a high surface finish that the tubing can be cut to length and used as is for hydraulic cylinders with soft-packed pistons. • Machining and honing costs are always cut to a minimum.



Send for these bulletins.

TUBE REDUCING CORPORATION
WALLINGTON, NEW JERSEY
• *New York City Tel: CHickering 4-0877*


THIS
is the kind of
ENGINEERING
HELP
we need!
Electronic Engineering in telemetering, guidance, radar and particularly circuit designing.
Hydraulic and Servo Engineering in control and autopilots.
Mechanical Engineering in packaging and structures.
W. C. Walker, Engineering Employment Mgr.
Pacific Division, Bendix Aviation Corp.
11620 Sherman Way, North Hollywood, Calif.
I am interested in this engineering field.
I am a graduate engineer with ____ degree.
I am not a graduate engineer but have ____ years experience.
Name
Address
City
Zone State

Continued

controlled machines are going to create a new combination of functions which must come within the realm of one person, or one group of people, and this will be a disturbing factor in present organizations. Schuman raised the point. "Is the operator going to be pleased with a machine which makes his work easier, or is he going to be displeased because there is less skill required in his work?"

Diminishing Returns: Interviewing machine tool manufacturers at the meeting, AH's editor received many varied opinions on the value of high cost numerical control. For the simple part in a small shop, use of a template and tracer control is certainly easier than preparing numerical information. For intricate parts such as three-dimension cams and turbine blades numerical control is justified. But the opinion of many is that for the vast majority of contour machining operations, tracer control is the most practical. We may be reaching the point of diminishing returns in attempting to eliminate all human skill completely.

Aircraft Manufacturing: Development of numerical control owes most to the requirements of the aircraft industry. Here production is primarily custom, and high production transfer machines have little application. Speaking from the airframe manufacturer's viewpoint, K. C. Wood, Boeing Airplane Co. discussed the compromises necessary between ideal design and feasible manufacturing. It is expected that numerically controlled machines will close this gap, in offering the possibility of manufacturing to optimum design. Asked about maintenance on these machines, Wood indicated that this would be handled by the user with help from the machine tool builder, and stated that many preparations are now under way for use of numerical control.

Developed by Airframe Manufacturer: At least one manufacturer—North American Aviation—has applied its computer and servo experience to develop its own numerical control. J. L. Bower described his company's control adapted to a Cincinnati Hydrotel. Indicating a savings of 50 to 80% even for one part, Bower stated that the machine has a maximum milling speed of 25 in/min. The cross feed and table are cylinder actuated with a pressure setting of 500 psi. The servo valve used in the system is one developed by the comapny. It is linear up to 800 cycles per sec, and a 120 cycle per sec dither is applied to it.

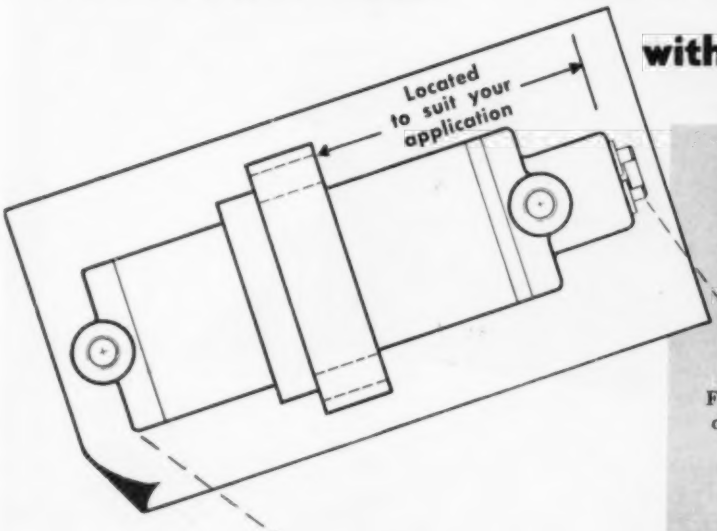
Cooperative Effort: Typical of many developments in numerical control was that discussed by R. C. Sims, Bendix Aviation Corp. His company developed the control and applied it to a specially developed machine built by a machine tool builder. This trend brings together the computer—servo people with the machine tool builders in a combined effort. Slides on the machine discussed by Bower are driven by rotary hydraulic motors. The feedback elements are inductive units without brush pick-up and with no contact with the moving slide.

Make More Money? Too many works managers remain satisfied with obsolescent machines because they're giving no trouble. The real criterion for deciding whether to replace a machine must be: Can you make more money with a new one? This was expressed by Tell Berna, General Manager, National Machine Tool Builders Assoc. At our present rate of production, it would take eight years just to replace the present machines in operation over 23 years, he said. We have 2 million metal cutting machines in the U. S. and at most our replacement is 1% per year. Also attacking problems of teacher shortages created by inflation and shortage of engineers due to poor mathematics training, Berna stated that what the country needs most is a sound dollar. ▼▼▼

"We Saved 25% of the Cost of Base Castings"

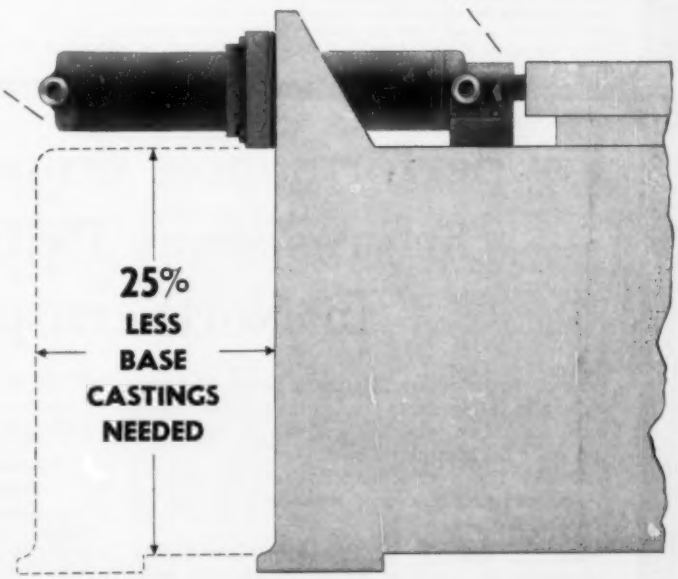
with

Pathon INTERMEDIATE FLANGE MOUNTING HYDRAULIC CYLINDERS



Application of the Pathon Intermediate Flange Mounting, as shown by the simplified drawing below, saved this machine company 25% of their base casting cost. Bonus advantages included reduced shipping weight, easier handling, and the universally recognized operating efficiency inherent in all Pathon Cylinders.

With Pathon Intermediate Flange Mounting Cylinders you choose whichever mounting position best suits your specific needs. Various heads of other mounting types may be combined with the intermediate flange to provide a large number of combination mountings. Thus special mounting brackets are eliminated. The cylinder is rotatable to any position for connecting pipe ports and mounting puds. Pathon Cylinders are available in the R. H. 2000 P.S.I. Series and the Q.H. 1000 P.S.I. Series.

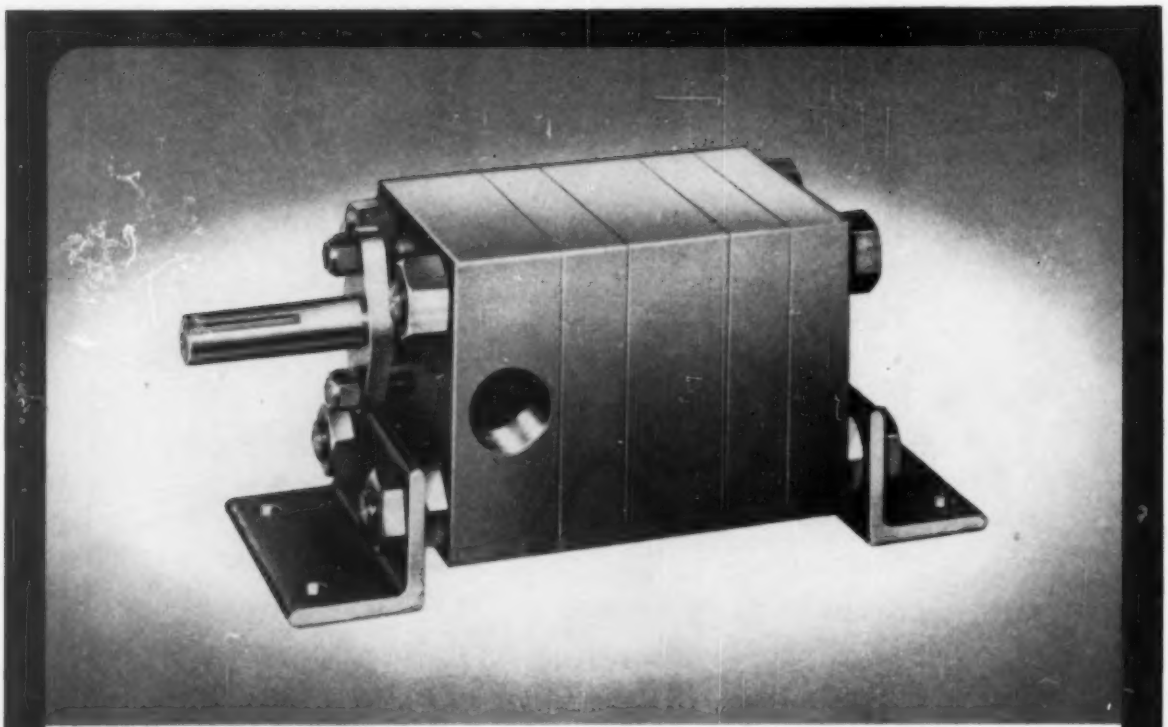


HAVE YOU A HYDRAULIC CYLINDER MOUNTING PROBLEM?

The chances are that one of the standard eight Pathon Hydraulic Cylinder mounting types or their combinations will adequately fill it. However, on any unusual Cylinder problem, we will be glad to help you reach a solution. Don't hesitate to write us.

Pathon MANUFACTURING CO.

3823 PACIFIC AVE. — CINCINNATI 12, OHIO



Northern Nitralloy Pumps are precision manufactured to extreme limits of accuracy . . . their unique block construction offers the widest choice of materials for functional elements. Nitralloy, nickel cast iron, bronze and stainless materials combine in an unusually functional design with precision manufacturing methods to pump liquids—from propane to adhesives and liquid CO_2 to molten lead. Northern Pump Company has the correct pump for any service.

for performance, economy, safety . . . fire-resistant Pydraul fluid in Northern pumps

What a combination! Here's a pump designed especially to eliminate friction losses and power wastage. When used with Pydraul, the result can only be maximum efficiency. You have no hydraulic fire worries with Pydraul because it's *fire-resistant*...plant and personnel are always protected.

Economy, too! . . . Pydraul lubricates like a petroleum oil, has a longer service life than most other fluids and is reclaimable. You can return spillage to the system . . . use it again and again. So in addition to being fire-resistant, Pydraul can actually save you money on fluid consumption.

If your hydraulic equipment is near hot metal, electrical contacts, open flame or other heat sources, you might be taking a needless fire risk. Your Monsanto representative will show you how easy and economical it is to convert to a firesafe Pydraul system.

Write for FREE Pydraul F-9 booklet. Organic Chemicals Division, MONSANTO CHEMICAL COMPANY, Dept. OEM-7, St. Louis 1, Mo.

Pydraul F-9—first and only hydraulic fluid listed by Underwriters' Laboratories

"In respect to fire hazard, Pydraul F-9 is rated by Underwriters' Laboratories, Inc., 2 to 3 in a class much less flammable than paraffin (Petroleum) oil, according to a schedule in which Ether is rated 100; Gasoline 90—100; Alcohol (ethyl) 60—70; Kerosene 30—40; Paraffin Oil, 10—20." *Pydraul: Reg. U. S. Pat. Off.*

LISTED UNDER RECOGNITION SERVICE UL OF UNDERWRITERS' LABORATORIES, INC.

MONSANTO

WHERE CREATIVE CHEMISTRY WORKS WONDERS FOR YOU

...AN AH STAFF REPORT....

Here are highlights, impressions and ideas gathered by editors of APPLIED HYDRAULICS at the 12th annual meeting of the National Conference on Industrial Hydraulics in Chicago, October 18 and 19. Abstracts of 23 of the 25 technical papers and the Conference program were published in the October issue of AH. If you want complete proceedings of the Conference, place your order with the NCIH Conference Secretary, Raymond Meade, Illinois Institute of Technology, Chicago, Illinois. Proceedings will be published early in 1957.

1956 NCIH

Atomic Applications

• **Hydraulic Control:** Hydraulically actuated control rods made the difference between a nuclear reactor and an atomic bomb. Describing a reactor as a device to achieve energy from nuclear fission under control, R. F. Humphreys, Armour Research Foundation outlined the chain reaction in U-235 which releases free neutrons with high kinetic energy. In an atomic bomb this chain reaction continues uncontrolled with the release of tremendous energy. In a reactor, control rods or neutron swallowers are hydraulically positioned for the removal of part of the neutrons.

• **Reactor Construction:** Many hydraulic problems are being solved in the current design of a reactor by Babcock & Wilcox. F. R. Ward indicated some of these in describing the problem of moving a load 4 ft in 1/3 sec and then decelerating to a stop. Other design features of this 500,000 KW generating station are sealing against 1500 psi, 300F water; proper alignment of certain hydraulic components, and control of bearing loads.

Asked whether radiation was a factor in design of hydraulic components, Ward stated that all hydraulic equipment will be in low radiation areas, and there would be no unusual problems.

Components

• **Relief Valves:** Pilot type can be used where internal leakage is not important. It does not have the degree of dependability of other types as force for closing is from a comparatively light spring. Don Stark, of Fluid Controls, who discussed this subject, pointed out that the differential piston and guided piston types have long life and are used considerably for machine tool applications. Poppet type is seldom used as it has a short life and wears quickly. It can be used where valve does not operate often and where no internal leakage can be permitted.

• **Filtration:** Is it necessary to filter out particles finer than 5 microns? According to H. W. Munday of Cuno, it is doubtful whether particles of less than 5 microns have any abrasive effect. Particles of colloidal size do little or no damage and particles one-half the hardness of the metal surfaces will cause little trouble. However, new lap fits will require filtration to one-half micron and less. Both metal filters and strong magnetic fields will be used for finer filtration.

• **High Pressure Trend:** In his paper on development of a high speed, high pressure gear pump, Pesco's Ernest Schanzlin emphasized the desire of mobile equipment makers for reliable 3000 psi hydraulic systems which would carry a reasonable price tag. Schanzlin predicted 3000 psi, 3200 rpm gear pumps by 1960 carrying a price tag of 15 to 20% above today's 1500 psi units.

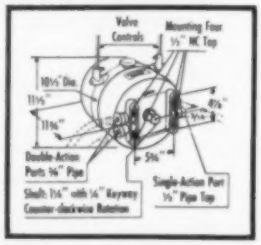
Continued on next page

Meet your Hydraulic Power Needs with this two-in-one power unit

- ✓ THE CHAR-LYNN POWER PAC has everything in one package needed for most all hydraulic operations.
- ✓ THE CHAR-LYNN POWER PAC encloses all parts within the reservoir for greater safety and longer life.
- ✓ THE CHAR-LYNN POWER PAC operates both single and double acting cylinders out of 1 unit.
- ✓ THE CHAR-LYNN POWER PAC delivers up to 10 Horsepower.
- ✓ THE CHAR-LYNN POWER PAC can operate at low speed and still deliver the high pressure needed for average operations.
- ✓ THE CHAR-LYNN POWER PAC eliminates sprockets, chains and pulleys.
- ✓ THE CHAR-LYNN POWER PAC offers space saving compact power at LOWER COST.

SPECIFICATIONS AND DIMENSIONS

DELIVERY. Up to 12 gpm. Up to 10 h.p.
RESERVOIR CAPACITY. 2½ gallons or more as needed.
RELIEF VALVE. Cartridge-type, spring-loaded, ball-check. Set 1,000 pounds.
CONTROL VALVES. Two-way Valve for Single-Acting Cylinder—Four-way for Double-Acting Cylinders.
FILTER. Enclosed within Reservoir—protects all moving parts. Fine brass screen easily cleaned or changed.
DRIVE. Direct from PTO shaft, or high-speed belt or chain drives.
OPERATING RANGE. 200-1200 rpm.



Hi-lo-pac pump

Strokontrol cylinder

Horsepower pump

Horsepower cylinder

Holdkontrol valve

H-730 coupler

F-240 filter

Catalog and Engineering Data Free on Request

Char-Lynn COMPANY

Dept. AH-12,
2843-26th Ave. So., Minneapolis, Minn.

Continued

• **Problems with Higher Pressures:** The advantages of size and weight reduction are attractive enough to warrant running head on into magnified problems caused by higher pressures. They are: sealing, improvements of oil properties, heat rejection, air entrainment, and filtration. More than ever, good pump life at 3000 psi is going to depend on the user.

• **Pump Design:** Key to successful high pressure pump design lies in relieving bearing loads and maintaining close manufacturing tolerances. If clearance is doubled, slippage gets multiplied by eight. Relief grooves on gear faces for filling and trapping helps prevent build up of hydraulic loads.

• **Vapor-Liquid Ratio Gage:** Using radioactive materials to measure density of fluids in pipe lines has the advantage of giving a measurement without introducing any device into the pipe line which would disturb the flow path. Richard K. Stoms described such a device for use on jet aircraft fuel systems. Calibration is a problem. Cost is in the $2000 range. Application to oil hydraulics has not been made.

• **Higher Temperatures:** Life of a pump designed for 500F is only a fraction of that of a pump designed for 275F. Does this penalty of lower efficiency and life matter much on missile applications? Aircraft and missile designers expressed present day need for equipment which can operate at 700F. Jack Murray of Pesco said that new principles of pump operation will have to be developed for operation over 550F. A system must be developed to separate entrained vapor or to operate without being affected by vapor. New materials, new fluids and simplified mechanical motions are required. Is there any temperature at which hydraulic operation may become impractical? To this question, Vickers' Duncan Gardiner expressed his belief that 1000F might be the limit.

Materials

• **Teflon:** Products from this material should be designed and engineered for each application; not merely substituted for leather or fibre. Teflon has no true melting point and is subject to the limitations of powder metallurgy due to its lack of flow. Material offers exceptional abrasion resistance and extremely low coefficient of friction.

• **Nylon:** Material is useful in check valves. Nylon works well at 280 to 300 F, but at 490 F the material disappears. Nylon or any soft material should be used so that mating part can regenerate the softer surface. For example, a hardened ball will continue to reform the nylon seat.

• **Fluids:** ASTM's new Technical Committee N is working on specifications, methods of testing and nomenclature of fire resistant hydraulic fluids.

Nine subcommittees have been established. Performance must be defined according to different end uses. Four subcommittees will cover requirements for using hydraulic fluids in aircraft, industrial, marine and mobile applications. Testing methods for fire resistance, lubrication characteristics, stability and compatibility will be studied by four committees, and one group will cover adaptability of existing ASTM methods of testing for petroleum type oils to synthetic fluids. Established standards do not apply to the new fluids and there are also differences between synthetics.

Mobile Equipment

• **Power Steering:** According to Ross Gear's, Ralph Lehman, air power steering is not furnished on original equipment. It is used as a field attachment since air compressors are available in trucks for braking systems. Future of air power steering is limited by low pressures in use. 75 to 80 psi requires large cylinders—difficult to find room to install. At present all equipment used has a standby mechanical system. However, with vehicles of 30,000 pounds and higher, the standby system will not be practical. Present speed of steering is about 1/2 second for full left or right hand turn.

• **Diesel Engine Starter:** Presenting the design of a new hydraulic Diesel engine starter, John Smith of Allison Div., General Motors, cited applications in which a hydraulic starter was advantageous over battery powered electrical starter. These included use in inflammable atmospheres, and under cold weather conditions. He pointed out that the torque potential of the hydraulic starting system is basically the same at all ambient temperatures and is dependent on system pressure.

• **Fluid Motor Design:** The fluid motor designed for the starter consists of a seven-piston, wobble-plate motor, a control valve, over-running clutch, and manually operated lever system to actuate the control valve and move the over-running clutch into engagement. Using an engine cranking speed of 300 rpm, with data on the breakaway and cranking torques of the engine, as well as an average gear ratio, the motor displacement was calculated at 2 cu in per rev.

• **Accumulator Design:** A piston type accumulator was designed into this starter system. It consists of an extruded steel cylinder which is closed at one end, a meehanite piston with an O-ring seal and two back-up rings, and either a cast ductile iron or forged steel end cap. The accumulator is precharged with dry nitrogen to 1250 psi.

Servosystems

• **Valve vs pump:** Comparing the performance of valve controlled servomechanisms to variable displacement pump controlled systems, Gerhard

Continued on next page

Do you have the facts on Linear's new, exclusive ROTO-MOLD process? It brings *automation* to the packing industry—makes possible fast delivery of perfectly uniform "O" Rings in any quantity!

★ Linear ROTO-MOLD "O" Rings are made with laboratory precision in single cavity molds under individually controlled pressure. Molding dies are automatically brought into microscopic alignment.

★ Every ROTO-MOLD "O" Ring is perfectly circular in cross section, with no transverse or other seams. You get precise uniformity without trimming or grinding.

Linear ROTO-MOLD "O" Rings are available now, in a variety of sizes and compounds, to meet your exacting requirements. Write, phone or wire for complete details.

"PERFECTLY ENGINEERED PACKINGS"
LINEAR
LINEAR, Inc., STATE ROAD & LEVICK ST., PHILADELPHIA 35, PA.

Circle 62 on Reader Service Card

Continued

Reethof and LeRoy Taylor, Vickers, Inc. pointed out the greater efficiency of pump because of the power dissipated in the valve orifices. However, the value of the valve controlled system is in the rapid response and low cost. Reethof indicated the low force level available for actuation of the first stage of electrohydraulic servo valves requires very close tolerances and extreme cleanliness to ensure reliability. This tolerance problem can be somewhat reduced by using a split-spool valve, either two 2-way valves for a 3-way combination or two 3-way valves for a 4-way combination.

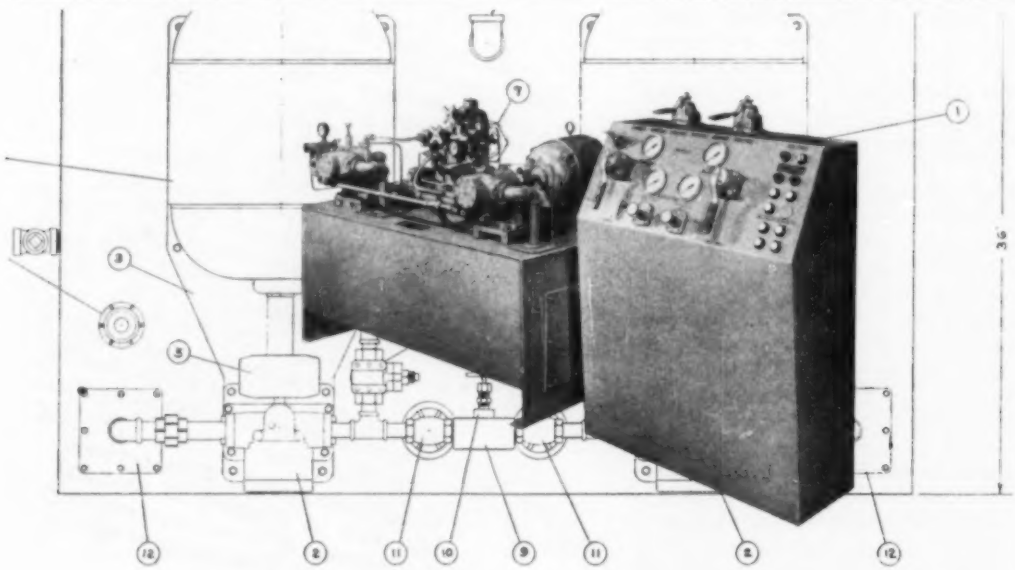
• **Single vs Multistage Valves:** Single stage valves contain far fewer parts than multistage units. Single stage valves with power outputs in the order of 6 hp have been built and operated successfully. However, Reethof stated that power levels above 6 hp require multistage servo valves because of the large flow forces.

• **Valve Actuation:** Listing the methods of transducing an electrical signal into a valve actuating force, Reethof named electro-magnetic, magneto-strictive, and piezo-electric. Of these the electro-magnetic has proven to be the most successful and widely used. The magneto-strictive is limited by the small motions available, and the piezo-electric is limited by the high operating voltages which are required and also by high ambient temperatures.

• **Servo Valve Sleeve:** The valve sleeve of a spool type valve presents probably the most difficult manufacturing problems of all the parts of the servo valve. For most applications, the tendency has been toward longer strokes to reduce the effects of clearance between spool sleeve, the rounding of edges, the "bell mouthing" effect of port squareness, and erosion of edges.

To obtain longer strokes and retain valve linearity, partial square ports have been devised. Methods for producing these square holes with sharp edges and with the hole axis perpendicular to the axis of the sleeve are broaching, electric arc burning, and ultrasonic machining. The combination of rough broaching and finishing with an ultrasonic path is a promising method.

• **Servos in Industry:** "Hydraulic servos which are being applied to large machines are employing even higher speeds of response than used in today's supersonic missiles, "stated Murray Kanes, Bendix Aviation, in discussing the application of servo-mechanisms to industrial processes. "In the past," he continued, "the benefits of fluid power coupled with automatic feedback control have been realized largely in the sense of reducing human effort or skill required in the control function. In the future, the emphasis will be toward increased automaticity.



Special distributing system on power unit supplies equal pressure to 3 separate control stations. Available flow: 8 GPM Dynamic—3 GPM Static, divided 3 ways.

APPLICATION
PAPER INDUSTRY

The CARDWELL MACHINE COMPANY
Franklin at 19th St., Richmond 11, Virginia • Phone 7-4593
Several attractive territories still open for qualified Hydraulic representatives.

REVISIONS	THE CARDWELL MACHINE CO. RICHMOND, VA.		
	CARDWELL SPECIAL POWER UNIT With Pneumatic, Hydraulic & Electrical Control Console		
	DATE 8-21-56	DWN. BY H.L.W.	9269-1
	CHK. BY C.L.H.	SCALE 3/8"=1'-0"	

and speed and dexterity of control beyond the human capacity of coordination.

Machine Tools

• **Transfer Machines:** One of the most important factors in determining whether to design an automatic transfer machine is continuity of operation where the completion of each operation initiates the next. This was expressed by A. H. Riddiford, Jr. of John S. Barnes Corp. Hydraulic operations on these machines include transfer of workpiece, actuation of locating pins, clamping, and tool feed. Outlining the company's electrical monitoring system, Riddiford stressed its importance in quick troubleshooting.

• **Pressure Safety Factor:** Because surge pressures of three to four times the relief valve setting may be encountered in a transfer machine system, components are operated at a fraction of their pressure rating. This also decreases maintenance and contributes to long service life.

• **Component Installation:** Arrangement of components for easy accessibility was stressed by Riddiford. Valves are pilot operated to eliminate the hammer action of large solenoids and are mounted on a single panel. J. R. Hemeon of General Motors commented on the necessity for foolproof construction in automatic machines, and indicated the importance of proper electrical control. Indicating arms on the solenoids to show the position of the solenoid is a desirable feature. ▼▼▼

Just off the Press!

Your FREE Copy Is Ready!

SEND for your *free* copy of the new Foster Quick Detachable Coupler Catalog—#110. Contains diagrammatic layout for applications. Simplified cataloging of coupler types and sizes in all price ranges. Fittings data, etc.

Send today for your free copy—no obligation, of course!

WE HAVE GOOD CONNECTIONS

FOSTER MANUFACTURING COMPANY, INC.

2350 GRAVOIS • DEPT. 13-C • ST. LOUIS 18, MO.

This Adams CYCLONE Saves You MONEY!

The Aftercooler and Separator that assures

DRIER Compressed Air

Here's real teamwork!... First, the Adams Aftercooler brings the compressed air temperature down — within 10 of the cooling water — where it holds almost 40% less moisture than air from conventional units. Then, the Adams Separator creates a cyclone to efficiently remove the condensate . . . giving you cooler, drier air for your system. Thousands in use throughout industry. It will pay you to find out all the details. Mail the coupon below today.

R. P. ADAMS CO., Inc.

Buffalo 17, New York

D-56

R. P. ADAMS CO., INC.
249 East Park Drive
Buffalo 17, N. Y.

Please send my FREE copy of Bulletin #711 on Adams Cyclone Separators and Aftercoolers.

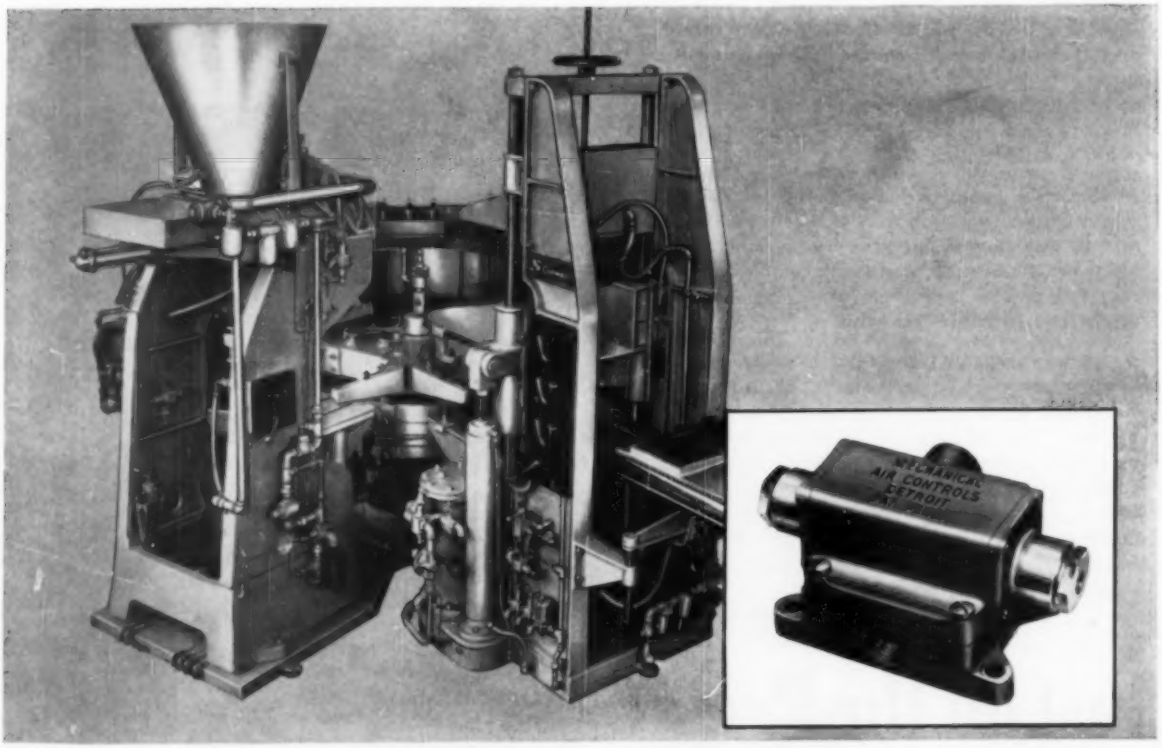
Name..... Firm .....

Street..... City ..... State .....

Circle 37 on Reader Service Card

Circle 3 on Reader Service Card

1200 SHELL CORES AN HOUR... and AIR DOES THE WORK



AUTOMATION COMES TO FOUNDRIES with Beardsley & Piper's new "Cormatic". Its intricate *all-air* control circuit features 33 MAC valves . . . provides the split-second operation needed to produce up to 1200 close-tolerance shell cores an hour using multiple core boxes.

MAC valves are showing up everywhere—*and well.* The "Cormatic" above proves the point. Here, on the latest in foundry equipment, 33 MAC valves are used. You can be sure they'll withstand dust, dirt and moisture . . . perform with maximum efficiency, minimum maintenance.

Why not check MAC for all *your* original equipment or replacement needs? You'll find MAC valves lighter, more compact, with fewer parts to wear. The line is complete, too—a wide range of sizes in pilot, pilot-operated and solenoid models.

***Write for free booklet,* THE MAC VALVE STORY. In layman's language, it tells you what you should know about the design and application of air valves—MAC valves in particular. Or contact a representative listed at right for your free copy. No obligation, of course.**

MECHANICAL AIR CONTROLS, INC.

Office and Factory—10030 Capital, Oak Park, Detroit 37, Michigan

MAC

Circle 67 on Reader Service Card

PHONE YOUR NEARBY "MAC" REPRESENTATIVE FOR DATA AND DELIVERY

CALIFORNIA
OAKLAND 8—The Rucker Co., 4700 San Pablo Ave., OLympic 3-5221
SOUTH GATE—The Rucker Co., 4956 Firestone Blvd., Kimball 8271

COLORADO (and NEW MEXICO, UTAH, WYOMING)
DENVER 16—Blair Engineering Co., 4100 Grape St., FLorida 5-7142

ILLINOIS
CHICAGO 43—Mike C. Modrich Co., 10918 South Western Ave., HIlltop 5-3640

INDIANA
FORT WAYNE 3—Neff Engineering Co., P.O. Box 2001, Station A, 2339 Crescent Ave., EAstbrook 7391
INDIANAPOLIS 20—Neff Engineering Co., P.O. Box 7361, 42nd St. Station, BRoadway 2330
SOUTH BEND—Dick Futter, 103 South Varsity Dr., CEntral 2-3800

MASSACHUSETTS (and New England)
BOSTON 34—Electrical Apparatus Co., Inc., 1200 Soldiers Field Rd., STadium 2-7440

MICHIGAN
BAY CITY—Fred Kober, 506 Chilson St., TWinbrook 2-2629
FLINT—Kober Sales Engineering Co., 514 Beach St., CEdar 8-5123
WESTERN MICHIGAN—Everett Adams, 17212 Sharon Road, Chesaning, Michigan, Chesaning 383-J-1

MINNESOTA
MINNEAPOLIS 4—Air Engineering & Supply Co., 2445 Nicollet Ave., FEderal 9-5579
ST. PAUL 14—W. H. Schulz Co., 2438 Franklin Ave., MIdway 4-2791

MISSOURI
ST. LOUIS COUNTY—Oscar E. Jost Co., P. O. Box 6, St. Ann, HArrison 8-4488

NEW JERSEY (Northern)
CRANFORD—The Roden Company, P. O. Box 305, CRanford 6-7330

NEW YORK
BUFFALO 21—C. H. Topas Co., 200 Washington Hwy., CIrcle 3210

OHIO
CINCINNATI—The R. W. Nichols Co., Fidelity Federal Savings Bldg., 2087-9 Sherman Ave., Norwood, ELmhurst 1-2440
DAYTON—The R. W. Nichols Co., 407 Realty Bldg., Michigan 4724
OLMSTED FALLS—The R. W. Nichols Co., P. O. Box 6, ADams 5-3366
TOLEDO 4—R. W. Nichols Co., 510 Manhattan Building, CHerry 1-1447

OREGON
PORTLAND—The Rucker Co., 911 N. W. Hoyt St., BEacon 0205

PENNSYLVANIA
PHILADELPHIA—Grand Air-Hydro Co., P.O. Box 141, Glenside, TUrner 7-4296
PITTSBURGH 22—The R. W. Nichols Co., 101 Investment Bldg., ATlantic 1-6050

TEXAS
DALLAS 19—Womack Machine Supply Co., Shea Rd. at 7150 Harry Hines, FLeetwood 7-3871

WASHINGTON
SEATTLE—The Rucker Co., 1000 4th Ave., South, MAin 2783

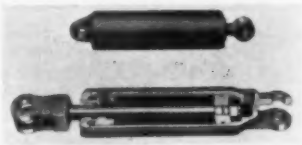
WISCONSIN
MILWAUKEE 17—Neff Engineering Co., 5856 N. Pt. Washington Rd., EDgewood 2-1579

MECHANICAL AIR CONTROLS, INC.
DETROIT 37, MICHIGAN
MAC

New Products continued

HYDRAULIC CYLINDERS
. . . use prestressed snap rings

Features: Cylinders are single and double acting, designed for operation up to 1500 psi, and meet SAE standards. Patented gland design is



employed, and a method of prestressing snap ring within the cylinder. Piston rods are heavy chromed and pistons are aluminum alloy to prevent corrosion and scoring. Honed seamless steel tubing is used for the cylinders, with welded cast steel mountings. Other features include adjustable "V"-rod packings and bronze wiper ring on the rod. Units are available in bore sizes ranging from 2 through 4 inches, and strokes from one inch through 18 feet.

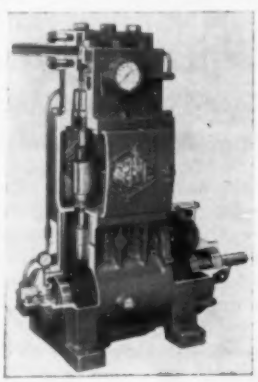
Densmore Engineering Co., Inc.
Compton, Calif.

Circle 135 on Reader Service Card

TRIPLEX PUMPS
. . . furnish heavy duty power

Designation: High Pressure Triplex Pumps and Power Units

Features: Pumps are designed to serve as high-pressure heavy duty sources of hydraulic power. They



are vertical, reciprocating plunger pumps, equipped with spring-loaded ball type valves with replaceable seats, a built-in lubricating oil pump for both pressure and splash lubrication, a scavenging pump to return plunger leakage to the system, and integral double reduction gears. Standard plungers are metal-to-metal fit, interchangeable for a wide variety of pressure and volume requirements.

Specifications: Pumps are rated from 15 to 60 hp and power units from 15 to 50 hp, with 5000 psi cylinder blocks. 20,000 psi cylinder blocks are available. All units are furnished with high pressure gauge, relief valve and flanges for inlet, discharge and relief valve connections.

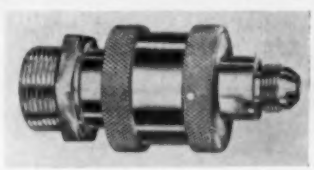
Kobe, Inc.
Huntington Park, Calif.

Circle 136 on Reader Service Card

SELF-SEALING COUPLING
. . . features maximum simplicity

Designation: Series 3200

Features: Meets Mil C-25427 specifications for use on airframe and aircraft engine hydraulic systems with temperatures up to 275 degrees F and pressures of 3000 psi.



Coupling replaces two shutoff valves and is particularly suited for installations where hydraulic line must be broken for maintenance or testing. Unit is quickly connected or disconnected and fast visual or touch inspection determines whether it is connected and locked. Connection is made by manual one-quarter turn of union nut; disconnection by an axial pull on the nut.

Aeroquip Corporation
Jackson, Mich.

Circle 137 on Reader Service Card

REDUCING VALVES
. . . adjust down to 25 psi

Designation: XGL-03-B & XTL-03-B

Features: Controlled reduced outlet pressure from 25 to 1000 psi can be provided. Reduced outlet pressure is maintained essentially constant, regardless of inlet pressure

Continued on next page

New Products continued

variations above the selected setting. Both models are nominally rated at 8 gpm flow capacity. Free reverse flow is allowable when pressure at reduced pressure port does not exceed the reduced pressure setting of the valve. Bleed control flow is approximately 35 cu. in. per minute.

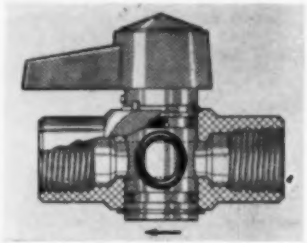
Specifications: Both valves are for use with ⅜ inch nominal pipe size at operating pressures up to 2000 psi. Dimensions of gasket mounted Model XGL-03-B are: 5-13/16 inches long, 2-¾ inches wide, 5-13/32 inches high. Model XTL-03-B is provided with ⅜ inch pipe thread connections and these dimensions: 5-25/32 inch long, 2-¾ inches wide, 5-13/16 inches high. Mounting sub-plates are available.

Vickers Incorporated
Detroit, Mich.

Circle 138 on Reader Service Card

PLUG VALVE
. . . provides leak-proof shut-off

Features: Operated by handle, valve requires no effort to open and close against pressure. Design features use of three O-rings. In closed position, one O-ring on surface of plug serves as a flow seal,



surrounding the inlet port and providing dead-tight shut-off. In open position the valve is full ported and allows a straight through flow passage. Static O-rings at top and bottom of plug and around its circumference prevent stem leakage. Using O-rings eliminates adjusting nuts and springs. Unit is made of brass and available in ¼ inch female pipe connections.

Circle Seal Products Co., Inc.
Pasadena, Calif.

Circle 139 on Reader Service Card

FIRE-RESISTANT FLUID
. . . protects at 150 degrees F

Designation: Houghto-Safe 1020

Features: Compounded expressly for systems operating at temperatures above 150 degrees F and for heavily loaded pumps and bearings. In addition to greater film strength and lubricity, this fluid is fortified with rust preventives and anti-foaming agents.

E. F. Houghton & Co.
Philadelphia, Pa.

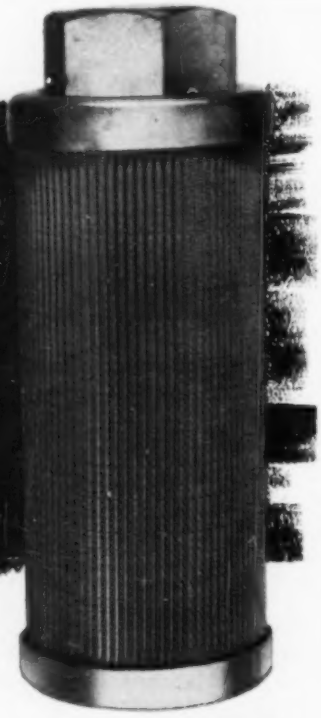
Circle 151 on Reader Service Card

Continued on page 116

Capital

HYDRAULIC OIL FILTER with Monel Metal Insert

Reservoir Type for Hydraulic and Oil Re-circulating Machinery



EASY TO INSTALL—EASY TO CLEAN
LONG LIFE—LOW COST—SIZES AND SCREENS TO FIT YOUR NEEDS

★ ONLY THREE PARTS
★ MEETS J.I.C. STANDARDS
★ GREATER FILTERING AREA
★ SPECIAL TRAP-WEAVE MESH

Specially woven MONEL wire cloth and a new method of compact corrugation, gives triple protection with less space than other filters of like capacity. Trap-weave mesh stops thin, elongated particles with NO loss of efficiency.

Non-corrosive, non-toxic materials throughout. Easily cleaned with an ordinary brush.

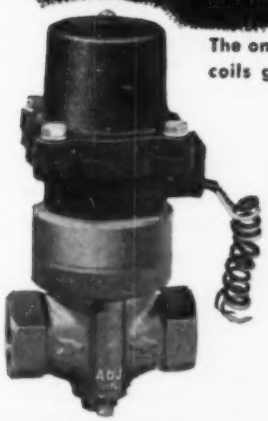
Write for descriptive circular.

CAPITAL ENGINEERING & MFG. CORP.

5836 SOUTH ASHLAND AVENUE, CHICAGO 36, ILLINOIS

Circle 45 on Reader Service Card

EXPLOSION PROOF Solenoid Valves FOR HIGH PRESSURES



The only solenoid valves made with coils guaranteed for one full year

Packless • ¼" to 2" • Full port area • Molded coils • Unbreakable piston rings • Adjustable cushioning control on opening and closing eliminates shock, maintenance; adds life • Manual opening saves expensive by-passing • Flow adjustment on ¾" to 2". • Oil-water pressures to 1200 psi; air-gas to 500.

Also general service and other special assemblies . . . Bronze and stainless steel

FREE BULLETINS!
Stainless Steel . . Bulletin K
Bronze . . . . . Bulletin 500 B

GOULD
SOLENOID VALVES

J. D. GOULD COMPANY
4707 MASSACHUSETTS AVE. • INDIANAPOLIS 18, IND.

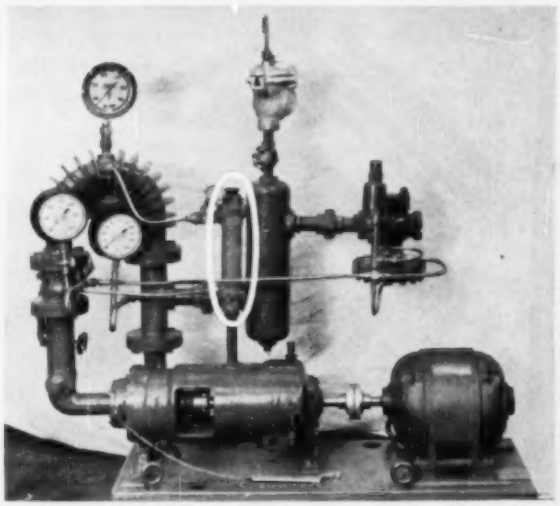
HONED Stainless Steel ROD ...at

NO extra cost

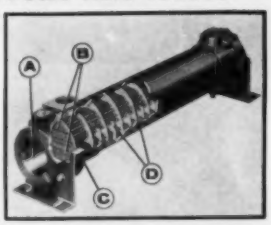
At no increase in price, **AIROYAL** small bore (⅝", 1", 1½" & 2") air and oil cylinders—always a good buy—have been even further improved. You'll buy them now with satin-smooth, externally honed, stainless steel piston rods. No more rust on rods, pitting or other surface imperfections. You'll enjoy the substantial increase in rod packing life. And look—price of 1"x1" cylinder, for 150 PSI air or 750 PSI oil service, is still only $28.00 list, $32.00 for pressures to 1500 PSI. **Write for catalog and prices.**

MANUFACTURED BY
THE AIROYAL CO.
1990 SPRINGFIELD AVENUE
MAPLEWOOD, N. J.
REPRESENTATIVES IN PRINCIPAL CITIES

Young Engineering Talent Pays off for Cochrane



Young Coolers—cut line losses in condensate return pump system



THE PROBLEM: To eliminate line losses between process equipment and Cochrane Condensate Booster Drainage Control Units.

How Young solved it

Young Type "F" Shell and Tube Heat Exchanger

Young Type "F" Heat Exchangers were specified to reduce water temperature 5 degrees before mixing it with incoming condensate at the mixing tube. Lowering the temperature of the fluid entering the mixing tube offsets line pressure losses . . . boosts pump efficiency.

A. Smooth flow bonnet distributes fluid with minimum turbulence.
B. Tubes are brazed into headers.
C. Gasket eliminates by-passing, fluid leakage.
D. Baffles made to close tolerance.

Write Dept. 446-M for FREE Catalog

Put Young Talent to work for you . . .

Solving heat transfer problems is what we do best because it is our very reason for being. You, too, can harness the power of Young engineering talent. Write, wire or call without obligation.

Young RADIATOR COMPANY
RACINE, WISCONSIN
Creative HEAT TRANSFER ENGINEERS FOR INDUSTRY
Heat Transfer Products for Automotive, Aviation and Industrial Applications. Heating, Cooling, Air Conditioning Products for Home and Industry.
Executive Office: Racine, Wisconsin, Plants at Racine, Wisconsin, Mattoon, Illinois

Circle 6 on Reader Service Card

Circle 119 on Reader Service Card

Circle 29 on Reader Service Card

RUGGED, HEAVY-DUTY
HYDRAULIC CYLINDERS

Attention: O. E. M.
Prompt delivery on any quantity . . . high quality . . . low cost!

Built-in Mechanical Stroke Control

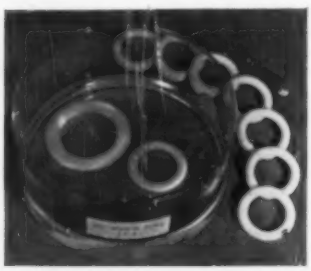
Free catalog and engineering survey, no obligation.

WRITE...PHONE...WIRE
CROSS MFG. CO.
LEWIS ■ PHONE 81 ■ KANSAS

New Products continued

HEAT-RESISTANT RUBBER . . . withstands swelling

Designation: SILASTIC LS-53
Features: This fluoro-silicone rubber has great resistance to swelling in contact with jet fuels, gasoline, high-aromatic oils and certain solvents. It remains rubbery from



—80 to 400 degrees F. The new compound is comparable to conventional silicone rubbers in tensile strength, ultimate elongation and compression set.
Specifications: Silastic LS-53 is supplied as a fully compounded material. It can be vulcanized in 5 minutes. Its use will be limited at present to essential aircraft applications.

Dow Corning Corporation
Midland, Michigan

Circle 140 on Reader Service Card

ROTARY CHECK VALVES . . . offer economy

Designation: Tactair Series 5900

Features: Manufactured to conform to MS-28880 and exceed MIL-V-5528 specifications, these rotary-type controllable check valves are for 3000 psi service. Valves are low-cost and may be used as all-purpose shut-offs for light applications, or for zero-leakage sequence operations.

Specifications: Internal parts are constructed with stainless steel in an aluminum alloy housing. Units have no leakage at 3000 psi and only 1 dpm at 5 psi. Temperature

TRU-O-SEAL
TEFLON SEAL

STOPS PIPE THREAD LEAKS instantly!

PAT. PENDING

Prevents future leaks!

TRU-O-SEAL does away with messy pipe "dope" compounds, eliminates damage caused by overtightening of conventional leaky joints, and is immune to ALL known hydraulic fluids and to steam, air, water, solvents, and practically all gases and chemicals. It withstands temperatures from —100° F. to plus 500° F., saves cost and labor of special or welded fittings, and has been fully field tested and proven by leading manufacturers. Comes in ⅛" to 2½" pipe thread sizes.

Write for data and prices

TRU-O-SEAL DIVISION
Flick-Reedy Corporation
2008 N. Hawthorne, Melrose Park, Ill.
"Miller Fluid Power" is also a Div. of Flick-Reedy Corp.

1 Thread TRU-O-SEAL on pipe or fitting (no messy pipe "dope" needed). SEAL SIDE

2 Thread pipe or fitting 4 threads into port. Point in desired direction.

3 Tighten TRU-O-SEAL to complete leakproof assembly (only light torque required).

INSTANT PRESSURE REGULATION
FROM 100 TO 3000 PSI
WITH THE Futurecraft HI/LO HAND LOADER

Proven Superior in Comparative Tests

Futurecraft CORPORATION
1717 N. Chico Ave. • El Monte, Calif.
WRITE TODAY for complete details

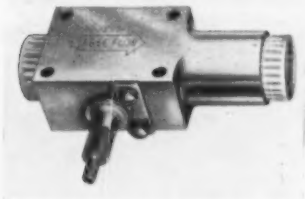
GENERAL SPECIFICATIONS

Port Size	¼" tube per AND 10056
Pressures	Operating—100-3000 psi Proof—6000 psi Burst—7500 psi Minimum
Flow	Exceeds any other loader available
Operating Temperatures	— 65° to + 250°F
Weight	2½ pounds

Circle 106 on Reader Service Card

Circle 40 on Reader Service Card

range of standard units is —65 to 160 degrees F, with special units



available for handling wider ranges. Cracking pressure is 2 to 8 psi. Available in three models to handle torque from 45 to 90 in.-lb.

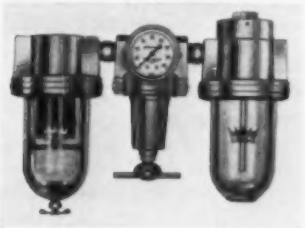
Tactair Valve Division
Aircraft Products Company
Bridgeport, Pa.

Circle 141 on Reader Service Card

AIR FILTERS, REGULATORS, LUBRICATORS
. . . offer simplified construction

Designation: Crown Line

Features: Units feature modern design and simplified construction, providing effective filtration, regulation and lubrication with mini-



mum power loss. Designed for use in compressed air lines throughout industry, units offer advantages to users of air cylinders, air presses and air tools.

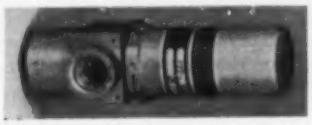
Sizes: Seven styles in 5 pipe sizes ¼ to 1". Regulator is offered in 1-¼" and 1-½" pipe also.

Hannifin Corporation
Des Plaines, Ill.

Circle 142 on Reader Service Card

PNEUMATIC PRESSURE REDUCER
. . . reduces pressure from 3000 psi

Features: Unit is completely bal-



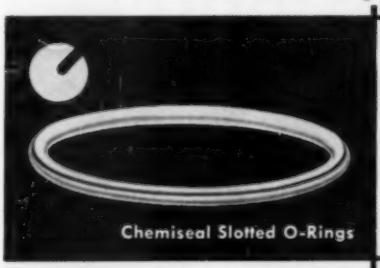
anced producing straight line regulation with leak-tight shut-off, high rated capacity and small initial

Continued on next page

in Hydraulic Packings... TEFLON outlasts all others

Chemically impervious du Pont TEFLON* is the ideal hydraulic packing material—has zero swelling in all hydrocarbons, new synthetic hydraulic fluids and solvents. Requires no chemical inspection. Offers unsurpassed anti-friction properties. Is tough, resilient, non-flammable, long wearing. Has wide service temperature range from minus 110° F. to plus 500° F.

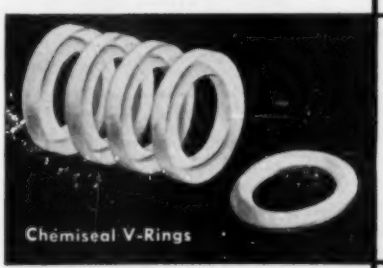
...and the best in TEFLON are Chemiseal Hydraulic Packings


Chemiseal Slotted O-Rings

CHEMISEAL SLOTTED O-RINGS (patented) provide greater cross-sectional deformability, thermal expansion compensation and automatic pressure sealing action. Designed to fit standard AN grooves.

Chemiseal Back-up Rings

CHEMISEAL BACK-UP RINGS prevent synthetic rubber O-Ring extrusion and greatly lengthen their life. Spiral, solid and split ring types are available in all commercial and AN sizes.


Chemiseal V-Rings

CHEMISEAL V-TYPE PACKINGS of distinctive tapered "V" design offer greater flexibility and resiliency. Seal with lower gland pressure and reduce operating torque. Ideal for manual or automatically operated valves.

Write for further information.

*du Pont's trademark for its tetrafluoroethylene resin

UGS BELMONT

UNITED STATES GASKET CO.
CAMDEN 1, NEW JERSEY

Circle 107 on Reader Service Card

New Products continued

pressure drop under flow conditions. Normal temperature range is —65 to 225 degrees F. Higher temperatures are possible with slight modification of internal design. Built-in relief valve is standard, but reducer may be supplied without relief valve for special applications.

Specifications: Available in ¼ and ⅜ inch tube sizes. Larger models can be furnished. Weight: 0.4 to 0.6 pounds.

Pneu-Hydro Valve Corp.
East Orange, N. J.

Circle 143 on Reader Service Card

RING-WEDGE ADAPTER
. . . provides locknut action

Design: Male pipe thread pitch is cut on a straight shank and relieved by longitudinal slots to assume female taper of port and provide a locknut type action. Standard O-ring in hex body of fitting seals against adjacent flat area surrounding female port, with chamfer optional.

Features: Design gives user advantage of straight-thread sealing without converting existing hydraulic component ports from female taper to straight thread. Repeated assembly and pressure testing prove absolute sealing.

Petch Manufacturing Company
Detroit, Mich.

Circle 144 on Reader Service Card

GEAR PUMP
...for magneto drive mounting

Designation: Series 1500

Features: Pump is for direct mounting on the magneto drive of truck engines and gasoline power units. Unit operates at pressures to 1500 psi at 2000 rpm and is available with a large variety of special mountings.

Design: Pressure balanced wear plates keep volumetric efficiency high at all pressures. Balanced hydraulic forces on both sides of the plates maintain fixed clearances between plates and gear faces so oil slippage is reduced to a fixed minimum and frictional contacts are eliminated.

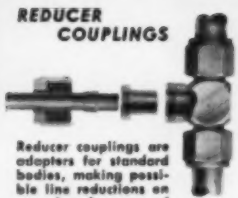
Kalamazoo Div.
New York Air Brake Co.
Kalamazoo, Michigan

Circle 145 on Reader Service Card

Continued on page 120

LENZ "O-RING"
NO METAL TO METAL SEAL
J.I.C. APPROVED
HELD BY FRICTION GRIP OF THESE TWO
NO CONCENTRATION OF STRESSES DUE TO FLARES OR FERRULES FOR TUBE FAILURE
NO EXACT TUBE LENGTH NECESSARY
NOT NECESSARY TO CUT TUBE SQUARE
SEAL AND GRIP ARE SEPARATE

REDUCER COUPLINGS



Reducer couplings are adapters for standard bodies, making possible line reductions on any leg by use of standard adapters and adapter nuts.

...A Hacksaw And A File Are All You Need

Excessive wrench torque is unnecessary for seal does not depend upon tightness of the nut. The higher the pressure the tighter the grip. Solve your hydraulic piping problems the easy way . . . with ease of assembly . . . no matching of exact tube lengths . . . simple leakproof connection for the life of the tube.

Reusable collet holds by friction grip up to bursting pressure of tubing.

LENZ FITTINGS MAKE THE JOB AS SIMPLE AS A B C

LENZ COMPANY

See our Catalog Page in Thomas Register 1956 Edition, Vol. 1, under classification "Fittings: Hydraulic" for complete list of types and sizes.

BOX 1044-A • DAYTON 1, OHIO

PHONE: ORegon 9364 • 3303 KLEPINGER ROAD

DISTRIBUTORS IN PRINCIPAL CITIES

Circle 60 on Reader Service Card

Circle 8 on Reader Service Card

A TECHNICAL NEWSLETTER ON LUBRICATION WITH MOLYKOTE . . .

IF YOU HAVEN'T RECEIVED YOUR COPY SEND FOR IT RIGHT AWAY!

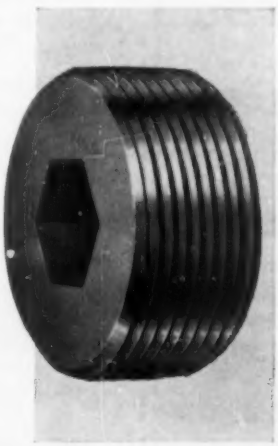
Every issue features a technical article on the use of MOLYKOTE Lubricants in industry ● "How-to" stories on tough lubrication applications ● Filled with engineering data which applies to all industries ● Being published regularly.

THE ALPHA MOLYKOTE CORP.

Main Factories: 65 Harvard Avenue, Stamford, Conn.
71 Arnulfstrasse, Munich 19, Germany

specify standard UNBRAKO®

Dryseal-thread Pressure Plugs for hydraulic or fuel systems



Use them wherever liquids or gases must be contained under pressure—or in place of ordinary pipe plugs. UNBRAKOs seal without compound. They are made of the same high-strength alloy steel, have the same internal wrenching feature as UNBRAKO socket screws. Fully formed threads exceed NPTF specifications. Standard sizes—1/16 to 1¼ in.—are stocked by your authorized industrial distributor. See him for details. Or write Unbrako Socket Screw Division, STANDARD PRESSED STEEL CO., Jenkintown 2, Pa.

UNBRAKO® SOCKET SCREW DIVISION
STANDARD PRESSED STEEL CO. SPS JENKINTOWN PENNSYLVANIA

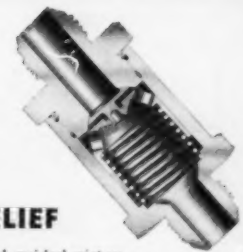
Circle 98 on Reader Service Card

REPUBLIC VALVES

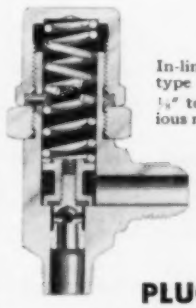
INDUSTRIAL • CHEMICAL • AIRCRAFT

CHECK

Quality Check Valves of several types—ball, poppet, Hy-pressure, Free-flow—all metals, various portings, and pressures up to 5000 psi. Pipe and tube sizes up to 2".



RELIEF



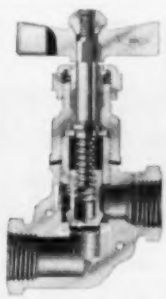
In-line and guided piston type Relief Valves. Metal or rubber seal. 1/8" to 3/4" pipe or tube connections. Various metals. Many settings to 2750 psi.

Also Pilot-operated type, with quick unloading and silent operation, 1/4" to 2" to 5000 psi. Remote control pilot available.

PLUG

Precision-made Plug Valves for wide general use in brass, aluminum alloy, or stainless steel, 1/8" to 1". +32° to 160°F. With Teflon plug, -65° to 250°F, without lubrication. Aluminum alloy or stainless steel.

GLOBE AND NEEDLE



Super duty shut-off valves, angle and offset, for up to 5000 psi service, 1/8" to 2", with mounting holes, and panel mounting brackets. Also high pressure Needle Valves for 10,000 psi. working pressure—proofed at 25,000 psi. One piece, stainless steel, 1/16" to 1/2".

LO-TORQ SELECTOR

Directional flow control for service up to 6000 psi. Balancing principle uses line pressure to make turning easy with short handle. 2, 3, 4-way, with various drillings. Side, bottom, and sub-plate porting. Panel mounting. 1/8" to 2".

Ask for new catalog, No. 654A, showing entire line.

Distributors in principal cities coast to coast.

CHECK RELIEF PLUG GLOBE NEEDLE

RM REPUBLIC MANUFACTURING CO.
15655 BROOKPARK ROAD • CLEVELAND 11, OHIO

Circle 87 on Reader Service Card

Circle 110 on Reader Service Card

One leak or a thousand . . . if you have a similar frustrating experience in a metal-to-metal static sealing problem, United's Metallic O-Rings are the answer!

They fit any application calling for a positive, permanent seal against internal or vacuum pressures up to 10,000 p.s.i., in a temperature range from –70 to 1800°F. They are especially adaptable for sealing cylinder heads, air and hydraulic pressures, high octane fuels, vapors, gases, oils, solvents, chemicals, acids, vacuum and steam connections. Available in various metals and finishes, ⅜" to any size or configuration.

For free 22 page booklet describing United Metallic O-Rings, write (on your letterhead please) to Department G-2.

UNITED METALLIC "O" RING CORP.
Dayton, Ohio • Box 1035
Division of United Aircraft Products, Inc.

FIVE BASIC METHODS FOR FINER, MORE DEPENDABLE HYDRAULIC FLUID FILTRATION ARE YOURS AT NO COST

HAVING TROUBLE? Why not send for the Briggs Hydraulic Manual today? Plants, large and small, have found this manual to be a genuine "trouble-shooter." It has helped them get the sure and trouble-free performance they want.

Briggs
PIONEERS IN MOTOR OIL FILTRATION

NO COST TRIAL
OF BRIGGS FILTER

Try any one of the 5 basic methods . . . try Briggs any way you want, at no cost.

HYDRAULIC OIL FILTERS

THE BRIGGS FILTRATION CO. DEPT. 139
WASHINGTON 16, D. C.
AT NO COST SEND THIS BOOKLET
NAME .....
COMPANY .....
ADDRESS .....

New Products
continued

AIR CYLINDER
. . . small, single acting

Designation: Model 091 Non Repair

Features: Unit has deep drawn cup stainless steel body and is single

acting with spring return. Finish of interior diameter is better than 10 micro inches. Front or open end of the body is securely fastened over the piston rod guide by rolling the front edge into a groove on the outside of the guide. This connection is permanent and can not be broken without destroying the body and the guide. New low cost method of construction and the stainless steel body result in long service life.

Specifications: Cylinder will exert a force equal to 0.9 of the air pressure line for a maximum stroke of one inch. Lock nut on front nose secures cylinder to mount.

Bimba Hardware & Manufacturing Co.
Monee, Ill.

Circle 146 on Reader Service Card

HYDRAULIC POWER PACKAGE
. . . is electric motor driven

Features: Envelope incorporates electric motor, hydraulic pump, valves and reservoir. Units permit wide latitude in systems design. They are powerful, small, compact and lightweight.

Application: Units are designed for guided missiles and supersonic air-

craft. Proven through complete performance, environmental and qualification testing facilities.

Adel Precision Products Division
General Metals Corporation
Burbank, California

Circle 147 on Reader Service Card

TEFLON HOSE ASSEMBLIES . . . have wide temp. range

Designation: Lin-Lok

Features: Units are capable of sustained operating pressures up to 4000 psi at temperatures from —100 to 500 degrees F. Offers maximum chemical resistance, freedom from contamination, wide temperature and pressure range, non-ageing, flexibility and ruggedness. Assembly consists of teflon liner encased in stainless steel wire braid with specially engineered full

flow fittings permanently locked to the hose.

Specifications: Eight sizes, range from 3/16 to 1-⅛ inches, with a maximum length of 50 feet.

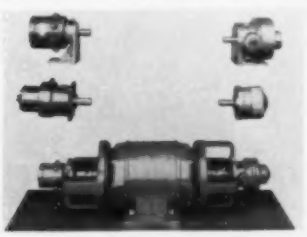
The Mic-Lin Company
Maple Shade, N. J.

Circle 148 on Reader Service Card

PUMP MOUNTING BRACKET . . . permits fast coupling

Designation: M & N Modern

Features: Bracket is designed to permit fast, easy coupling of hy-



draulic pumps to motors. Arrangement assures perfect alignment in minutes, and may be used with any standard make pump up to 10 hp.

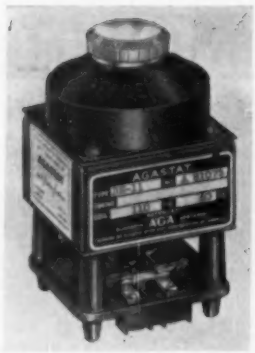
M & N Modern Hydraulic Press Co., Inc.
Clifton, N. J.

Circle 149 on Reader Service Card

TIME DELAY RELAYS . . . have dial head adjustment

Designation: Agastat

Features: Dial markings permit easy calibration for accurate adjustment, with each dial color coded to identify the timing range. Four ranges are available in the dial head model: from 1/10 to 3 seconds, 1/10 to 10 seconds, 10 seconds to 2 minutes, 30 seconds to 15 minutes. Units consist of pneumatic timing head, solenoid assembly, switch, coil and terminals.



Specifications: Relays are relatively unaffected by temperature changes from —65 to 160 degrees F. Available for continuous duty AC from 6 to 550 volts, 60 and 25 cycles, and intermittent service DC from 6 to 230 volts.

A'G'A' Division
Elastic Stop Nut Corporation
Elizabeth, N. J.

Circle 150 on Reader Service Card

Make Good Design Even Better . . .

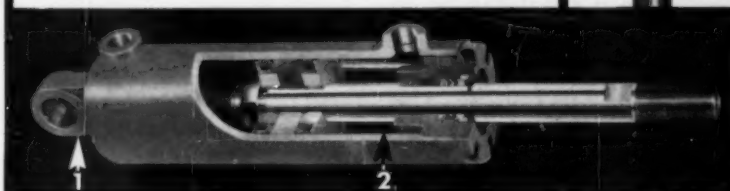
BHEW Made-to-Order HYDRAULIC CYLINDERS

Whatever your cylinder requirements, you're sure of dependable operational performance with efficient, close-tolerance BHEW cylinders that require minimum mounting space. Built to meet your specifications, their cost is reasonable; there is no charge for tooling; they are delivered on schedule.

BHEW CYLINDER FEATURES: • Standard and special designs available. • Double or single acting and telescopic. • 1½" to 8" bore. • Strokes up to 156". • Smallest possible O. D. and retracted O. A. length. • Oil cylinders with 1,500 psi or 3,000 psi working pressure, pneumatic up to 150 psi. • Cup-type, ring-type or O-ring construction. • Choice of mounting.

For full information, send us specifications of your requirements.

Double-Acting 2-piece Piston Rod Cylinder. It is excellent for extending and retracting boom arm. Both hoses are connected on rod end. →



1. Hinged mount for alignment.
2. Honed steel cylinder.

Do you have cylinder problems? Our engineers will be happy to work with you without charge.

BHEW BENTON HARBOR ENGINEERING WORKS, Inc.

622 LANGLEY AVENUE, ST. JOSEPH, MICHIGAN

Circle 17 on Reader Service Card

Since 1925 • in the application, design and manufacture—pumps separators, hydraulic accessories.

EQUIPMENT FOR FLUID POWER TRANSMISSION

What's your problem?

- higher pumping speeds?
- tolerance of particle-laden liquids?
- peak suction for primary pumps?

the Kraissl-50 Roller Pump

is unmatched for dependable performance on every one of those counts.

Bulletin A-1330 has full data . . . write for it. The roller-rotor design easily handles particles that would jam more tightly fitted mechanisms—reduces cavitation, allowing higher speed operation*—develops high suction characteristics.

*Roller mechanisms permit higher speeds with any oil than most displacement designs.

KRAISSL CO

566 Williams Ave., Hackensack, N.J.

Useful Literature continued

HYDRAULIC CYLINDERS . . . for 2000 psi service are illustrated and described in catalog 104 released by S-P Manufacturing Corporation. Units feature quick replacement of rod packing without dismounting cylinder. Packing cartridge can be taken out by removing a snap ring. Hydraulic pressure and flow data at pressures from 100 to 2000 psi is included in the specifications.

Circle 190 on Reader Service Card

TIMERS . . . for any control problem are available from Industrial Timer Corporation. Bulletin 4b-In illustrates and describes time delay timers, interval timers, recycling timers and running and reset time totalizers. When standard units or combinations cannot solve the problem entirely new timing units can be designed. The features and specifications of each type are covered briefly and illustrations of various models are shown. Units are synchronous motor driven.

Circle 191 on Reader Service Card

TORQUEMETERS . . . measuring from inch-ounces to thousands of foot-pounds are described and illustrated in Bulletin 4308 released by Baldwin-Lima-Hamilton Corporation's Testing Equipment Department. Unit consists of torque pick-up to provide electrical signal, and an instrument to translate the signal into units of torque. One application of this torque meter is on fluid motor test equipment.

Circle 192 on Reader Service Card

AIR VALVE DESIGN . . . and application is covered in non-technical language in a pocket-sized, 30-page booklet available from Mechanical Air Controls, Inc. Principles of valving, from water faucets; through evolution of simple straightway and poppet types actuated by air; and parts, structure and action of more complicated valves; are all covered in concise, easy-to-comprehend fashion. Booklet is entitled "The MAC Valve Story".

PRESSURE GAUGES . . . featuring a simple cam and roller design without gear teeth are described in Catalog G-52 issued by American Chain & Cable Company, Inc., Helicoid Gage Division. Gauges use a Bourdon tube with the "Helicoid" cam and roller system. This movement is explained in detail as well as the components of the gauges, with illustrations of all assemblies. Details and specifications are given for the various models along with illustrations and a list of recommended uses. Units are available in bronze, alloy and stainless steel and monel metal. A single diaphragm chemical model is available filled with inert liquids. Various types of cases may be specified including a flush type weatherproof design for panels.

Circle 193 on Reader Service Card

GASKETS, SHIMS, WASHERS . . . produced by Chicago-Wilcox Mfg. Co. are illustrated and described in a variety of styles, shapes and materials in their 28-page catalog. Data is included on ring, cylinder head, double jacket, corrugated metal, plain solid, self-sealing and special types of gaskets. An added feature is a listing of 1500 stock dies available which can save the cost of dies.

Circle 194 on Reader Service Card

TEMPERATURE CONTROLS . . . for extreme sensitivity, are illustrated and described in Fenwal catalog MC-135. Units cover temperature range from—100 to 1100 degrees F with variation of only 3 to 5 degrees. Literature gives specifications, performance data, temperature ranges and describes various modifications and special features.

Circle 195 on Reader Service Card

SOCKET SCREWS . . . produced by Cleveland Cap Screw Company, are described in 4-page illustrated folder. Sizes and specifications are given on the complete line, including cap and set screws, flat and button head cap screws, shoulder screws and dowel pins.

Circle 196 on Reader Service Card

Continued on page 124

Circle 13 on Reader Service Card

Atkomatic

stick-free SOLENOID VALVES

end valve binding
at extreme temperatures

Unbreakable piston rings provide "free-floating" piston action.

No valve binding—even at 450° F above zero, or 300° F below—when you specify Atkomatic! Atkomatic's unbreakable piston rings compensate for expansion and contraction through extremes of hot and cold. They assure free-floating piston action, keep valve body walls free of deposits. This means less wear and longer valve life.

Atkomatic offers a complete line of 2-way valves for automatic control of liquids, air, gas and steam. Bronze or stainless steel. Pressures: 0 to 5000 psi. Packless, full ported, leak proof.

write for FREE 20 page catalog 200-A

ATKOMATIC VALVE CO., INC. Dept. 3A
545 West Abbott Street, Indianapolis, Indiana

You get 10 big Integral-Motor-Pump advantages in these two NEW types (three models) of

GAST ROTARY AIR PUMPS

Model 0211
1/6 hp, to 1.3 cfm, 25 psi or 27" vac.

Model 0321
1/4 hp, to 2.2 cfm, 25 psi or 28" vac.

Model 0521
1/3 hp, to 3.8 cfm, 20 psi or 28" vac.

*0321 similar in appearance.

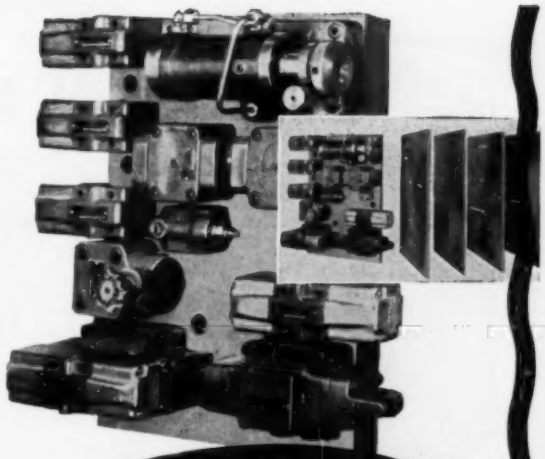
1. Latest type G.E. "Form G" motors.
2. More compact than other pumps.
3. Total weight reduced 1/3—cuts shipping costs.
4. Motor mounting time and labor eliminated.
5. Simple, trouble-free rotary-vane design.
6. Vanes take up their own wear automatically.
7. Positive displacement, pulseless air delivery.
8. Improved appearance—smoother exterior.
9. Dependable for original equipment; plant use.
10. Forced air fan cooling on Models 0321 & 0521.

Write for new Bulletins V-356 and P-356! Gast Manufacturing Corp. P. O. Box 117-D, Benton Harbor, Michigan.

Original Equipment Manufacturers for Over 25 Years

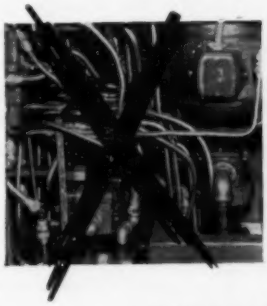
GAST ROTARY
• AIR MOTORS TO 4 H.P.
• COMPRESSORS TO 30 P.S.I.
• VACUUM PUMPS TO 28 IN.
See Our Catalog in Sweet's Product Design File

Circle 42 on Reader Service Card



ALMO
HYDRAULIC CONTROL MANIFOLDS

CONTROL SYSTEMS READY FOR OPERATION — NO CIRCUITS TO PONDER OVER AT INSTALLATION



Leading machine manufacturers use these manifolds to cut costs and obtain permanent trouble-free operation. Send your hydraulic circuit print and sketch showing desired take-off connections. We'll prepare a manifold proposal—No obligation.

Write for full details

ALMO TOOL COMPANY
11470 Kaltz — Centerline, Mich.

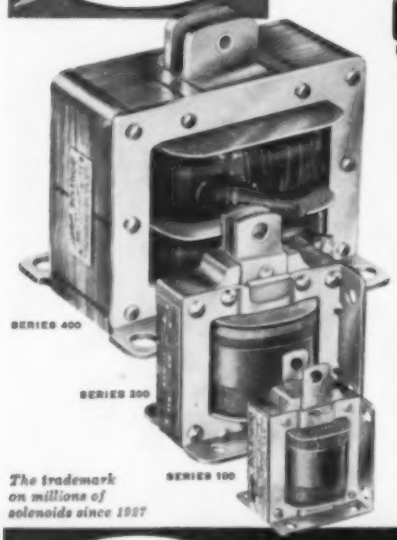
"Design Wise"

Colonial Broach Co. uses an Almo manifold in this 15 ton capacity, 66" stroke dual-ram broaching machine.

Circle 120 on Reader Service Card

Circle 118 on Reader Service Card

WesCo has the AC solenoids you need... in the quantity you need!



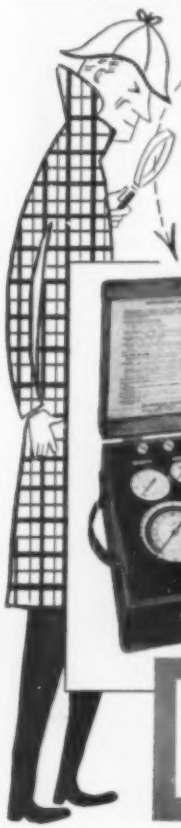
The trademark on millions of solenoids since 1937

WesCo's famous Series 100, 200 and 400 AC solenoids—75 models in all—are immediately available in small or large quantities! One of these designs may fit your requirements. If not, WesCo engineers will design a special solenoid for your application. Inquire now.

WesCo designs and manufactures aircraft solenoids for military and commercial application. Write for complete catalog.

WesCo WEST COAST ELECTRICAL MFG. CORP.

233 W. 116TH PLACE • DIVISION 119 • LOS ANGELES 61, CALIFORNIA • PLymouth 5-1138



Locate the trouble quickly — easily in your hydraulic system

Schroeder Portable Hydraulic Circuit Tester

The new Schroeder Hydraulic Circuit Tester speedily checks the operating efficiency of your hydraulic circuit components.

Weighing only 19 pounds it is housed in a convenient, sturdy carrying case, size 7" x 11" x 8¾" and can be carried without effort to the machine location. After the proper connections are simply made, by rubber hose, the tester simultaneously measures the temperature, pressure and flow from the component port under test. The unit has a pressure range of 300 to 2000 PSI and a maximum flow of 50 GPM.

Check out your hydraulic system's operation—order a Schroeder Portable Hydraulic Circuit Tester today—literature and prices on request.

SCHROEDER BROTHERS CORPORATION

HYDRAULIC, ELECTRIC AND PNEUMATIC EQUIPMENT

NICHOL AVE. McKEES ROCKS, PA. SPALDING 1-4810

Useful Literature continued

SAE BOSS FITTINGS . . . for new SAE Straight Thread Boss Standards are manufactured by Anchor Coupling Co., Inc. Their SAE Boss Fittings Catalog illustrates and describes the complete new line, including O-ring adapters. Also shown are tube nuts available in short nut, SAE long nut and 3-piece assembly styles.

Circle 197 on Reader Service Card

TIMERS . . . electric synchronous motor driven . . . are manufactured in 400 various types to individual specifications by Industrial Timer Corporation. Catalog is available covering standard models, including automatic and cam recyling, multi-cam, single cycle cam, single cycle multi-cam, time delay, and instantaneous reset timers.

Circle 198 on Reader Service Card

FLOW TRANSMITTERS . . . pneumatic and electric are manufactured by Brooks Rotameter Company. Pneumatic unit employs direct force balance to minimize mechanical motion, providing low inertia characteristics and improved response time. Electric unit utilizes strain gage element. Standard model is explosion-proof and can be used with almost any receiving instrument. Applicable to automatic logging and data reduction. Schematic drawings, details of operation and design characteristics of Transi-Twins transmitters are covered in Bulletin 170.

Circle 199 on Reader Service Card

CYLINDERS . . . for air and hydraulic applications, are manufactured by Hydair Cylinder Corporation. Units are precision designed and built, available in 11 bore sizes and 15 mounting models. Detailed specifications are given along with diagrams and cutaways. An interchangeability chart is included.

Circle 200 on Reader Service Card

HYDRAULIC & PNEUMATIC COMPONENTS . . . manufactured by Aircraft Products Co., are presented in their 72-page bulletin 156. Engineering drawings, tables and flow charts give construction and operating specifications on standard items. Also included are special components for aircraft and general use.

Circle 201 on Reader Service Card

TERMINAL BLOCKS . . . for quick electrical connections are covered in condensed catalog 556 released by Curtis Development & Manufacturing Co. Entire line of blocks and kits is given with complete technical description, specifications, including selector chart.

Circle 202 on Reader Service Card

PHOTOELECTRIC CONTROLS . . . are manufactured by Autotron, Inc. for every purpose. Widely varied applications to industrial use are illustrated in 16-page catalog 57. Equipment described includes controls from moderate to ultra sensitive, photoelectric and electronic timing controls and a variety of light sources.

Circle 203 on Reader Service Card

SYNDUCTION MOTOR . . . bulletin 51B-8440A has been released by Allis-Chalmers Manufacturing Company. Motor provides constant synchronous speed from no load to pull-out regardless of load . . . simple across-the-line control . . . high efficiency . . . relatively high power factor . . . simplified maintenance. Bulletin lists information needed for specification and quotation on individual applications.

Circle 204 on Reader Service Card

HYDROLUBE . . . safety fire-resistant, hydraulic fluids produced by Carbide and Carbon Chemicals Company Division of Union Carbide and Carbon Corporation are described in their 12-page bulletin. Ucon Hydrolubes consist essentially of water, ethylene glycol, high viscosity lubricant, thickening agent and selected additives. Bulletin covers properties, laboratory pump test data, limitations, maintenance and control of hydrolube fluids.

Circle 205 on Reader Service Card

THERMOMETERS . . . providing accurate, sensitive, rugged instruments for industrial use are produced by United States Gauge Division of American Machine and Metals, Inc. Gotham units incorporate a light, sturdy bulb chamber, shallow v-shaped case, wide flat scale and red-reading-mercury glass tube, for maximum response to temperature changes, visibility and reading accuracy. Available in a variety of angle forms, sizes, connections, fittings and ranges. Catalog 101 gives engineering specifications, illustrations, and a temperature conversion table.

Circle 206 on Reader Service Card

Continued on next page

Here's the way National insures uniform high quality in National O-Rings:

All ingredients are of highest quality, carefully inspected before compounding. Compounding is done under strict controls to insure absolute uniformity of batches. Molding is done on modern equipment by skilled veterans in O-Ring manufacture. Rings are given a complete precision trim, then complete inspection. Every precaution is taken to insure that no O-Rings with cuts, scratches or mold defects are shipped.

A complete line of industrial O-Rings, including the new small cross-section rings, is available for prompt shipment from convenient warehouses. Prices are most competitive. Call the nearest National Applications Engineer and prove this to yourself!

NATIONAL
OIL & GREASE SEALS
O-RINGS SHIMS

N A T I O N A L S E A L
DIVISION, Federal-Mogul-Bower Bearings, Inc.
GENERAL OFFICES: Redwood City, California
PLANTS: Van Wert, Ohio and Redwood City, California

CHICAGO, ILL. . . . *Room 462, McCormick Building, HArrison* 7-5163
CLEVELAND, O. . . . 210 *Heights Rockefeller Bldg., LEllowstone* 2-2720
DETROIT, MICH. . . . . 13836 *Puritan Avenue, VErmont* 6-1909
DOWNEY (Los Angeles Co.), CALIF. . 11634 *Patton Rd., TOpaz* 2-8163
INDIANAPOLIS, INDIANA . . . 2802 *North Delaware St., WAlnut* 3-1535
MILWAUKEE, WIS. . . . . 647 *West Virginia Street, BRoadway* 1-3234
NEWARK, *N. J.* . . . . . 1180 *Raymond Blvd., MItchell* 2-7586

Circle 73 on Reader Service Card

Useful Literature continued

PIPE THREAD SEAL-FITTINGS . . . providing leakproof sealing of pipe thread elements with light torque and without paste or compound are produced by Flick-Reedy Corporation's Tru-Seal Division. Bulletin gives directions for use and indicates possible applications for this seal. Can be used on any pipe thread, on almost any fluid or gas, at pressures up to 3000 psi and temperatures from —280 to 500 degrees F.

Circle 207 on Reader Service Card

FEED-SPEED PACKS . . . simplify fluid power application and provide precision fine feeds and high traverse speeds. "Any-Feed Paks" are built in four sizes by the Oilgear Company. Two sizes of pressure compensated variable displacement, radial rolling piston pumps for pressures up to 1000 psi provide constant coarse or fine feeds regardless of load variations. Two constant displacement traverse pumps for pressures up to 300 psi provide high traverse speeds to cut down cycle time. Bulletin 44200-A shows four oil flow diagrams, oil and electrical circuits, typical machine cycles, electric control components and JIC pump and base installation drawings.

Circle 208 on Reader Service Card

AIR AND OIL VALVES . . . featuring positive leakproof sealing at low or high pressure and maintenance-free dependability are manufactured by Circle Seal Products Co., Inc. Bulletin S-2021R gives technical characteristics with cutaways on check, shuttle, relief and shutoff valves.

Circle 209 on Reader Service Card

CIRCUIT BREAKERS . . . using hydraulic-magnetic principle with inverse time-delay features, are produced by Heinemann Electric Company. Bulletin 3411 describes the hydraulic-magnetic principle, design, operation and application of unit. Schematic diagrams, time-delay curves and other helpful engineering information are included.

Circle 210 on Reader Service Card

TUBING . . . of high quality, at lower cost than seamless, is produced by Superior Tube Company. Weldrawn tubing is made by forming cold-rolled strip into tubing, fusion welding the edges, and then cold drawing to size. Data Memorandum No. 2 describes the process and gives tables of analyses and production limits and tolerances.

Circle 211 on Reader Service Card

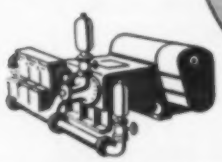
RELIEF VALVES . . . ¾ and 1-inch differential piston type, have been added to the line manufactured by Fluid Controls, Inc. Valves feature rugged construction and good pressure-flow characteristics for applications where failure to hold pressure would endanger life and equipment. Pressure acts on annular area between the O.D. and the reduced diameter of the piston. Units are adjustable between 1500 and 3000 psi.

Circle 212 on Reader Service Card

Many PROBLEMS — One SOLUTION

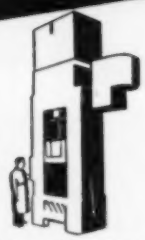
Speeds operation, reduces spillage and breakage by absorbing shock.

Stores tremendous power for starting engines.



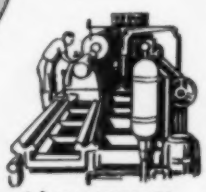
Dampens pump pulsations to prevent failure and damage to system.

U. S. Patents under Olaer Licenses



Lets small motors and pumps operate big presses.

Reduces size, cost, weight, complexity of machine tools.



Furnishes emergency power when pump fails.

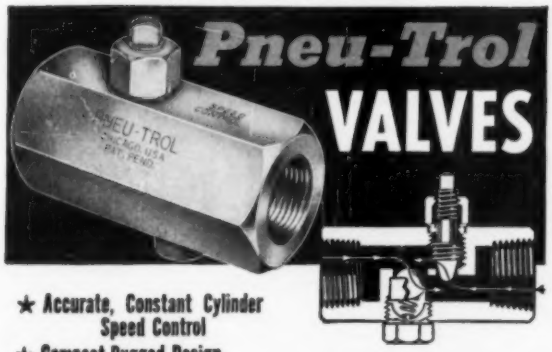
Planning a new product? Improving your present equipment? It will pay you to consider using the Greer Accumulator. The application of the most versatile hydraulic component ever devised means improved performance, lower manufacturing and maintenance costs, and greater on-the-job efficiency for your hydraulically operated equipment. Learn how the Greer Accumulator can help you as it has so many others. Write or call Greer engineers for technical assistance with recommendations. No cost or obligation, of course. **Write for Bulletin 301-A for data and diagrams today.**

GREER HYDRAULICS INC. • NEW YORK INTERNATIONAL AIRPORT • JAMAICA 30

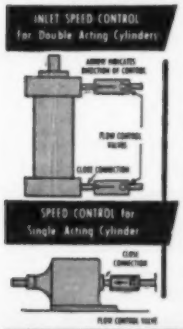
Circle 43 on Reader Service Card

Circle 82 on Reader Service Card

Pneu-Trol VALVES



★ Accurate, Constant Cylinder Speed Control
★ Compact Rugged Design
★ Simple, Easy Speed Selection ★ For Air, Oil or Water Applications



Pneu-Trol Speed Control Valves. are widely used in hundreds of control applications because they combine in a short, compact body, a tapered fine thread needle for extremely accurate air or oil flow control and a floating retro ball check, which permits full flow in the opposite direction. Retro ball floats in most sensitive position to its seat, requiring only a slight differential pressure to fully open or close it.

Needle design permits maximum flow capacity in the controlled direction. Metal to metal needle and ball seats insure long trouble-free service. Simple, practical "O" gland structure eliminates troublesome leaking. Valve bodies machined from hex brass or aluminum for 2000 psi working pressures; steel and stainless steel for 5000 psi. Made in 5 female pipe sizes—⅛" to ¾". ATTRACTIVE PRICES . . . IMMEDIATE DELIVERY.

Write for illustrated circular and prices.

Pneu-Trol DEVICES, INC.
1426 N. KEATING AVENUE • CHICAGO 51, ILL.

Circle 51 on Reader Service Card

"Wipe out" PACKING FAILURES WITH Seal-Guard METALLIC ROD WIPERS

Self-adjusting, easy to install, Seal-Guard's knife-like bronze rings "wipe off" all dirt and grime, will not mar the rod, are oil and heat resistant and friction-free.

HOW SEAL-GUARD WORKS

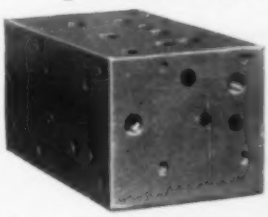
1. Twin wiper rings are mounted on rod with notches staggered.
2. Cushion ring is compressed on assembly exerting constant inward pressure keeping ring in constant contact with rod.
3. Harmful substances are completely cleared by scraper action.

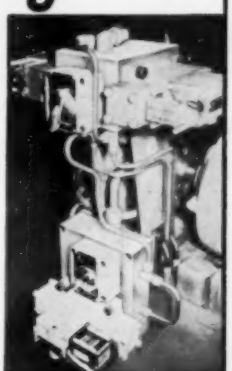
Seal-Guards are available to fit rod diameters from ¼ to 24 inches. Other sizes by special order.

WRITE FOR DESCRIPTIVE LITERATURE.

HYDRAULIC ACCESSORIES CO.
24301 Hoover Rd. Van Dyke, Mich.

Your manifold problems Solved





We are Drilled Manifold Specialists! We can manufacture to your specifications . . . or design special manifolds to fit your needs.

Will accommodate from ⅛" to 1½" valves.

Drilled manifolds of solid ground steel offer such advantages as:

- LOWER COST
- COMPLETELY LEAK-FREE
- MORE COMPACT
- BETTER APPEARANCE
- EASY VALVE SERVICING

Send for FREE Booklet

Birmingham Hydraulic
DRILLED MANIFOLDS 14540 Schaefer, Detroit 27, Mich.

AIR-MITE HIGH PRODUCTION AIR PRESS with more Quality Features

★ Solid Steel Column. Greater strength and rigidity.
★ Brass cylinder, aluminum end castings, Hy-Car piston cups.
★ Accurately ground table.
★ Fast set-up and stroke adjustment.

You don't have to "baby" an AIR-MITE Press because they're ruggedly built to stand the gaff of production work. From the tip of their solid steel column to the heavy base, they're every inch a workhorse tool. Feature-for-feature, you can't buy a better, more economical operating press than an AIR-MITE.

Special adaptations available. Write us your needs.

1 Ton Capacity
$89.95
F.O.B. Chicago

New 3 Way Control Valve. For safer, more efficient press work, use AIR-MITE Control Valves. Connected in parallel and positioned on either side of an air press, they provide a safe, instantaneous press operating control. Operator must depress both handles to actuate press . . . keeps attention on work-piece, hands out of the way. For pressures up to 160 p.s.i.

AIR-MITE Devices, Inc.
4415 W. CARROLL AVENUE, CHICAGO 24, ILLINOIS

Circle 18 on Reader Service Card

Circle 5 on Reader Service Card

Post Scripts of Industry

News about people, manufacturers and sales organizations

Jack L. Modrich
Hydair Cylinder Corp.

Jack L. Modrich, who has been associated with the fluid power field for 15 years, has announced formation of **Hydair Cylinder Corporation,** with plant facilities in Cudahy, Wisconsin. Modrich is president and general manager of this new air and oil cylinder manufacturing company.

W. H. Bennett
Hydraulic Press Mfg. Co.

W. H. Bennett has been appointed president of Koehring Company's **Hydraulic Press Mfg. Co.** Division, Mount Gilead, Ohio. Bennett joined H-P-M in 1939. Most recently he was vice president in charge of sales.

A. Robert Rutan, Jr.
International Packings Corp.

Blackhawk Manufacturing Company's Hydraulic Control Division has announced the formation of **Dynex, Inc.** The new organization will be affiliated with Blackhawk and use the trade name. Dynex executives are: **Wesley R. Master,** director of engineering; **Hugh T. McGee,** chief application engineer; **A. Dunn,** director of manufacturing; **William H. McGill,** manager of original equipment sales; **Harold L. Robinson,** manager of distributor sales and **W. K. Massoth,** controller.

International Packings Corporation has appointed **A. Robert Rutan, Jr.** as supervisor of their synthetic division. **George H. Favorite** has been named Purchasing Agent.

Howell Electric Motors Company, Howell, Michigan has announced promotion of **A. B. Wright** to manager of the Chicago district office. **T. A. Armstrong** has been named assistant sales manager in the Howell office and **H. D. Lewis** was made manager of industrial sales. **Francis L. Sherman** has returned to Howell headquarters and assumed charge of Gearmotor sales.

Walworth Company has acquired **Grove Valve and Regulator Company** and **Grove Controls, Inc.,** both of Oakland, California. The Grove companies have a new plant in Longview, Texas.

Ellison L. Wefel offers consulting service for the metal extrusion industry, specializing in oil hydraulic equipment problems. Wefel was formerly vice president of Lombard Corporation.

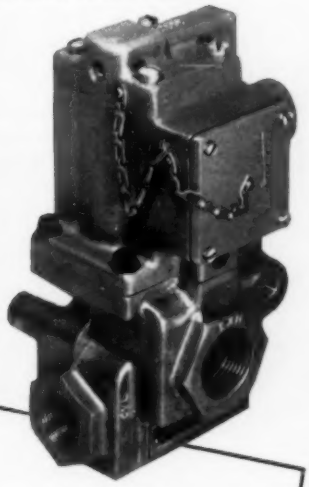
The Weatherhead Company, Cleveland, Ohio, has organized a new corporation to acquire the assets of Eastern Aircraft Products Corporation and Eastern Precision Parts Company, Inc., Orange, New Jersey. This new corporation operates as a Weatherhead subsidiary, retaining the name of **Eastern Aircraft Products Corporation** and continuing operations of the Eastern companies.

Continued on page 130

Circle 14 on Reader Service Card

J.I.C.
IN-LINE 3-WAY SOLENOID VALVES

1/4 · 3/8 · 1/2 · 3/4 · 1 · 1 1/4



- NORMALLY CLOSED OR OPEN
- CONTINUOUS DUTY SOLENOIDS
- MOST A C & D C VOLTAGES

Write for Bulletin—Prices

COMPLETE LINE OF

Air Control Valves by

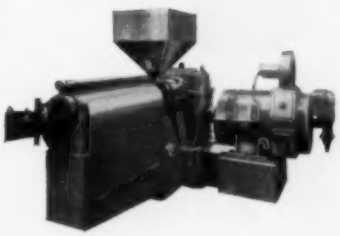
AUTOMATIC VALVE CO.

37415 GRAND RIVER AVE • FARMINGTON, MICH.

five important services

- ★ Hydraulic Presses for the Plastic, Rubber and Engineering Trades. Baling Presses for fibres and metal.
- ★ High Pressure Pumps, Valves and Accumulators for all industrial applications for oil or water.
- ★ Extruding Machines for rubber and plastics, with complete ancillary equipment for wire, sheeting and tubing. Injection moulding machines.
- ★ Greer-Mercier Hydro-Pneumatic Accumulators, Hydraulic Line Shock Alleviators, Gauge Protection Valves, Pressure Switches, Electric, Gas and Steam Hotplates, Heat Circulating Units and Exchangers.

DAVIS-STANDARD EXTRUDERS assure high velocity extrusion with maximum operating efficiency. Fawcett-Finney engineers, with an intimate knowledge of the extrusion industry's needs and problems, will be glad to confer with you to determine the most efficient installation for your operation.



THE GREER-MERCIER HYDRO-PNEUMATIC ACCUMULATOR can provide a smoother and more economical operation of hydraulic systems. A variety of sizes is available for a multiplicity of uses.

FAWCETT-FINNEY HIGH PRESSURE PUMPS for oil or water enjoy an enviable reputation for efficiency and long service. The mobile type illustrated, is a single or two stage pump suitable for pressures up to 5,000 P.S.I.

FAWCETT FINNEY LIMITED

FAWCETT-FINNEY LIMITED

BERKLEY STREET · BIRMINGHAM 1

In Association with FAWCETT PRESTON & CO LTD · BROMBOROUGH · CHESHIRE and FINNEY PRESSES LIMITED · BERKLEY STREET · BIRMINGHAM 1

Telephone: MIDland 3795-6-7 Cables: Finhyd Birmingham 1

A METAL INDUSTRIES GROUP COMPANY

Check with LYNAIR ON YOUR AIR AND HYDRAULIC CYLINDER REQUIREMENTS FIRST!

REGARDLESS OF YOUR NEEDS WE CAN SUPPLY THEM

Check these Advantages

- √ We engineer and manufacture Air and Hydraulic Cylinders for every application
- √ Cylinders meet J. I. C. standards
- √ Airdraulic cylinders for controlling feed in both directions
- √ New design Piston Packing assures minimum of bypass on hydraulic cylinders
- √ Complete range of sizes, 1½" bore through 8" bore, standard. Larger sizes on request.
- √ A full range of Air and Hydraulic Boosters.

Delivery to meet your requirments.

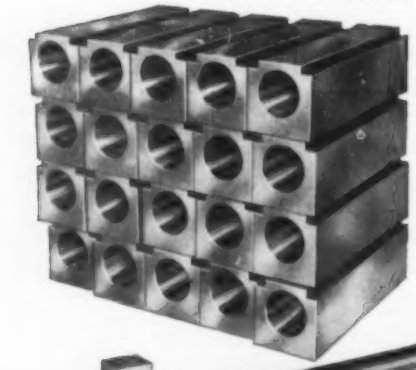
WRITE FOR NEW CATALOG

LYNAIR Inc. 3100 E. MICHIGAN AVE. JACKSON, MICHIGAN

Circle 63 on Reader Service Card

Circle 68 on Reader Service Card

Circle 9 on Reader Service Card



Hydraulic CYLINDERS to specification

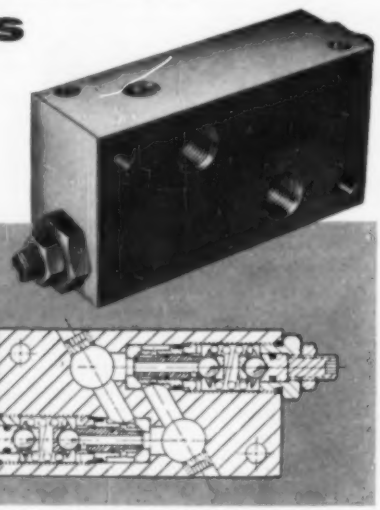
AT your service — since 1918 — the most modern machine tools to handle up to 15" I. D., including the last word in honing equipment and the most accurate of precision gauging equipment. Everything we do is to specification. Expanded facilities permit prompt delivery of 1 or 1000 pieces in any material desired.

Call Erie 2-3664 - Send specifications to

AMERICAN HOLLOW BORING COMPANY

1954 Raspberry St., Erie, Pa.

Fluid Motors Need Dual Relief Protection



NEW!

DUAL RELIEF VALVES

- **Prevent excessive pressures at motor ports when valves are suddenly reversed or blocked.**
- **Assure smooth safe starting or deceleration of large loads.**
- Available in Guided Piston or Differential Piston designs
- For Oil
- 600-1500-3000 P.S.I.
- ⅜", ½", & ¾" pipe sizes.

Write for detailed information and prices.

Fluid Controls, inc.

Manufacturers of Hydraulic Valves and Devices

Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Special Valves
Pressure Compensated Flow Regulators

1284 N. CENTER STREET • MENTOR, OHIO

Post Scripts of Industry

continued

Vickers Incorporated, Detroit announced appointment of three assistant chief engineers in the ground mobile hydraulic products sections. **R. H. Hallman** is in charge of design development and test for passenger car and light trucks section. In earthmoving equipment, heavy trucks and buses section **Glenn M. Jones** has charge of design, development and testing. **Clare E. Hellenberg** is in charge of hydraulic equipment for farm machinery and materials handling equipment section.

R. H. Hallman
Vickers, Incorporated

Glenn M. Jones
Vickers, Incorporated

Clare E. Hellenberg
Vickers, Incorporated

H. D. Federer has succeeded **E. M. Gage** as president and general manager of **Teer, Wickwire & Company,** Jackson, Michigan.

H. D. Federer
Teer, Wickwire & Company

Promotion of **William H. Mann** to sales manager of the **Skinner Electric Valve Division** has been announced by the **Skinner Chuck Company** of New Britain. Mann has been with Skinner since 1948.

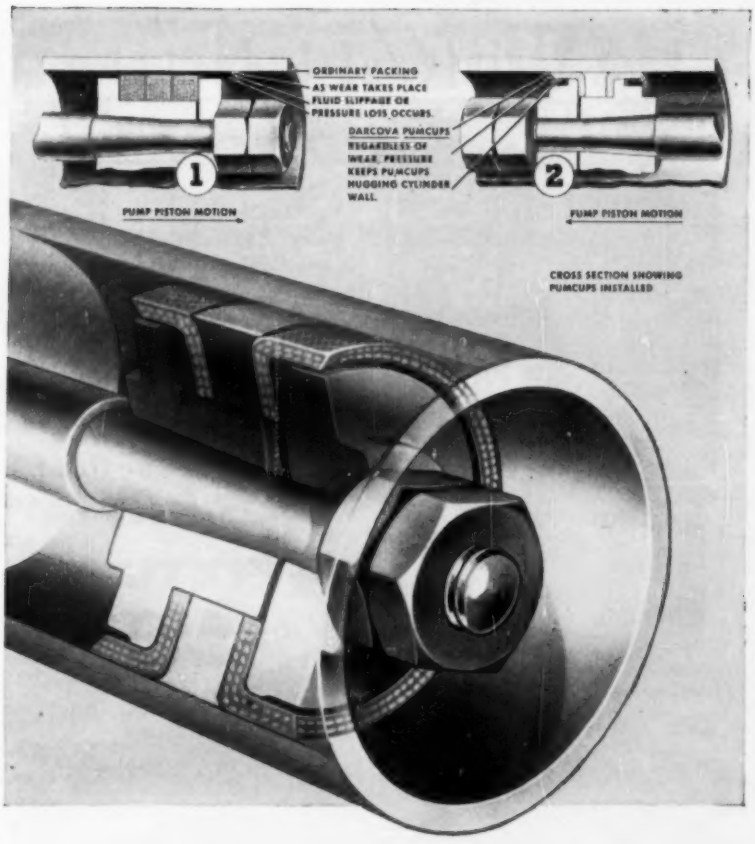
Haskel Engineering & Supply Company's San Francisco branch has moved to new and larger quarters at 225-11th Street, San Francisco, California.

Appointment of **Barker Rockford Company** as sales representatives has been announced by **Double A Products Company,** Manchester, Michigan. Territory includes northwest Illinois and Iowa counties bordering the Mississippi River. **Pierce Barker,** owner of Barker Rockford, was formerly with Vickers Incorporated.

Ralph R. Ryan has become sales representative of the Detroit District for **Babcock & Wilcox Company's Tubular Products Division.** Millard A. Hammond has been named manager of the division's welding fittings sales section. His headquarters will be at the Milwaukee plant.

E. A. Irion has been named a district application engineer in **Clark Controller Company's** Pittsburgh office. Irion was previously with the Syracuse office.

Continued on next page



DARCOVA PUMCUPS mean EFFICIENCY to cost-minded engineers!

IN air and hydraulic cylinders and reciprocating pumps Darcova Pumcups actually retain full efficiency *throughout* their life span . . . and they outlast most other packings at least 3 to 1!

Special texture engineering plus the Darcova Pumcup principle makes it possible for Pumcups to hold their peak volumetric efficiency. Moreover, Pumcups permit equipment to be operated at reduced speeds, save power, prolong equipment life and eliminate the need for frequent replacement shutdowns.

For less maintenance and lower operating costs find out more about Darcova Pumcups. Write for Bulletin No. 4502 on Pumcups for air or hydraulic mechanisms, Bulletin No. 4401 on Pumcups for reciprocating pumps.

DARLING VALVE & MANUFACTURING CO.
Williamsport 15, Pa.

DARCOVA
THE ORIGINAL COMPOSITION CUP
PUMCUPS

Post Scripts of Industry
continued

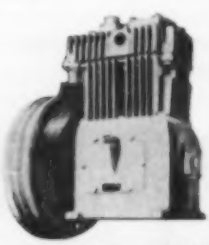
Air-Draulics Company, 31 South Third Avenue, Phoenix, Arizona was appointed distributor for **Parker Appliance Company's Rubber Products Division** in the Arizona region. **Ray Browne** and **Myer N. Wilson** will head the firm.

Universal Engineering Company, 1414 48th Avenue, Oakland, California, has been appointed a representative for **Hankison Corporation** of Pittsburgh. **Charles Morris** and **William Smith** of Universal will handle the San Francisco area.

To boost production, consider the FIXTURE FACTOR

For example — simultaneously drilling 12 oil holes in a piston. This manufacturer designed a *fixture* to up production. The operator slips the piston wrist pin hole over the bar under the frame on the upper fixture. Then he flips a valve handle . . . Quincy compressed air plunges the bar down, clamps the piston in the fixture below.

Often the main way you can boost production is to speed up the fixture, particularly when you're burdened with older equipment. You can also use Quincy compressed air to operate clutches and chucks . . . remove metal cuttings . . . operate hand tools, hoists and precision gages.



But be sure your compressor is a Quincy. Features like loadless starting and Safe-Q-Lube give you a steady supply of air years longer. 21 models from 1 to 90 c.f.m. Ask for Folder 300. Write today to Dept. AH-1256.

Quincy COMPRESSORS

QUINCY COMPRESSOR CO. • QUINCY, ILLINOIS

Promotion of **Chedo P. Graham** to chief engineer has been announced by **The Aro Equipment Corporation** of Bryan, Ohio. Graham came to Aro in 1954 as assistant chief engineer.

Chedo P. Graham
Aro Equipment Corporation

Arthur E Benson has been appointed development manager of the international division of **United States Rubber Co.** Previously Benson was manager of tire design in Detroit.

B. L. Binford, formerly chief engineer, has been elected vice president in charge of manufacturing of **Magnetrol, Inc.** of Chicago.

Gladden Products Corporation of Glendale, California annouced appointment of **Don P. Kingsley** as assistant to the president. Previously Kingsley was sales manager of the aircraft products division.

Don P. Kingsley
Gladden Products Corporation

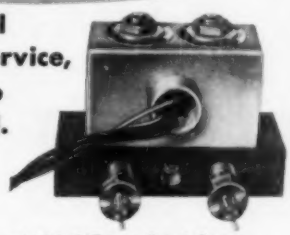
Gar Precision Parts, Inc., Stamford, Conn. has appointed **Byron Nierenberg** as chief application engineer. He was previously with N. Y. Air Brake Co.

Circle 71 on Reader Service Card

Modernair

NEW ¼" SOLENOID VALVE

for Air or Oil Hydraulic Service, 30 to 150 p.s.i.



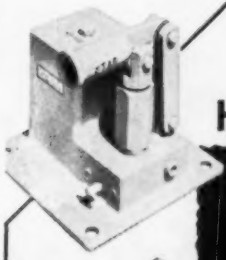
★ ULTRA COMPACT...only 4-9/16" long, 3-5/16" high, 1-3/4" wide overall!
★ NON-CORROSIVE CONSTRUCTION...brass and aluminum throughout.
★ "O" RING SEALS...replaceable without disturbing piping.
★ AVAILABLE IN SINGLE OR DOUBLE SOLENOID for all popular a.c. or d.c. voltages.
★ 3-WAY (3 port) OR 4-Way (5-port) MODELS, with or without exhaust speed control valves as shown. Standard ports are female 1/4" NPT.

MODERNAIR's new BV Series ¼" solenoids put the answer to scores of fluid power control problems literally in the palm of your hand. Why not get the facts now? Write or wire for specifications, prices.

Modernair CORPORATION
Trademark
Dept. B-12, 400 PRETA ST., SAN LEANDRO, CALIF.
Member National Fluid Power Association 20

Circle 99 on Reader Service Card

STAR SINGLE PISTON HYDRAULIC PUMP



LOOK INSIDE— SEE WHAT YOU'RE BUYING

- Spring loaded multiple chevron piston packings for lifelong service.
- All pistons chromium-plated to guard against abrasions.
- SAFETY BY-PASS VALVE to prevent overload dangers.
- Gauge opening.
- 60 cu. in. reservoir or smaller or larger to specifications.
- ½", ¾" or 1" pistons with 1½" stroke.
- 24" or 30" levers, as desired.

Ask for catalog #555. Special engineering counsel cheerfully submitted on request.

Representative areas available.

STAR JACK CO., INC.
420 LEXINGTON AVENUE, NEW YORK 17
PLANT: RIVER GROVE, ILLINOIS

METAL HOSE? TEFLON HOSE?

MAYSON has a companion Hose Swivel for these high quality hoses. This Swivel handles steam, solvents, detergents and high pressure, temperature and speed.

Your Mayson Dealer will be glad to give you complete information on this new Hose Swivel.

MAYSON MFG. CO.
4332 HORATIO STREET • DETROIT 10, MICH.

FAST DELIVERY on NOPAK shelf-stock AIR CYLINDERS!

Your choice of —
- 6 Mounting Styles
- 8 Bore Sizes
- 9 Stroke Lengths

When you specify NOPAK "Shelf-Stock" Air Cylinders you save money 3 ways:
1. You eliminate waiting for "specials".
2. You reduce engineering costs.
3. You get top quality NOPAK Air Cylinders at the lowest possible prices.

NOPAK "Shelf-Stock" Air Cylinders are available in a wide range of bore sizes and stroke lengths from 1½" x 1" to 8" x 15". No other manufacturer offers such a wide range of selection in Brass Tubing, Precision Machined, Cushioned Air Cylinders at comparable prices.

MODEL "E" with Clevis and Mounting Bracket

NOW! 5" BORE replaces the 4½" bore in the NOPAK Shelf-Stock line, with no price change — extra cylinder power at no extra cost. Compare quality and prices, and you'll specify NOPAK. Write for Current Listings and Catalog 101.

GALLAND-HENNING NOPAK DIVISION • 2743 S. 31st St., Milwaukee 46, Wis.

NOPAK *VALVES and CYLINDERS*
A-6-701-19

Circle 66 on Reader Service Card

Circle 41 on Reader Service Card

1956 APPLIED HYDRAULICS Editorial Index

ACCUMULATOR CIRCUITS

5 Ways to Use Accumulators
By Seymour S. Garrett Sept. p 76

Intensifier and Accumulator Circuit
By E. W. Friedl Mar. p 78

Pilot Check Times Accumulator Action on Spike Pulling Machine
Aug. p 51

ASSOCIATION AND TECHNICAL MEETINGS

Along the Aisles at the 1956 ASTE Industrial Exposition Mar. p 103

Fifth Transport Aircraft Hydraulic Conference Feb. p 78

Highlights of SAE Aircraft Meetings June p 94

High Temperature Problems Featured at Turbojet Engine Symposium
Mar. p 118

Electrical Conference on Machine Tools Dec. p 102

Machine Tool Hydraulics Forum
July p 65

National Conference on Industrial Hydraulics Oct. p 102

National Conference on Industrial Hydraulics Dec. p 107

Summaries of Technical Papers to be Given at 12th NCIH Oct. p 105

AVIATION APPLICATIONS

Delta Backup Ring for Dynamic Sealing Oct. p 142

Fluid Motors Combine with Analog Computers to Test Jet Controls
By Robert G. Butterwick
Nov. p 119

How to get Accurate Flow Readings When Testing Aircraft Components
By William M. Richner
Nov. p 111

How To Use Self Sealing Couplings
By Robert J. Dawson Apr. p 92

Hydraulic and Pneumatic Problems in High Performance Aircraft
By Ralph E. Middleton
Dec. p 98

Hydraulic Fluids for 400 F.
By Harry M. Schiefer and Bernard Rubin July p 102

Hydraulic Powered Flying Controls —Part 1 and Part 2
By John A. Lankester Feb. p 71
Mar. p 111

Integrated Control Systems for Aircraft
By R. Hadekel Dec. p 95

Jet Engine Control . . . Servo Pump or Servo Valve
By L. D. Taylor May p 119

Load Limiting Devices for Retractable Aircraft Cylinders
By P. Person Sept. p 106

Self-Displacing Accumulator Shortens Lines and Minimizes Pressure Losses
By Scott Hawkins and E. R. Cooper
Aug. p 80

Synthesis of Aircraft Hydraulic Servos
By George R. Keller and Elliott R. Buxton Dec. p 90

Valve Design for High Pressure and Delivery
By John A. Lankester Oct. p 138

What's Titanium's Future in Aircraft?
By Don F. Collins May p 124

CIRCUIT DESIGN

New Ideas for Pressure Control on Oil Hydraulic Equipment
By Robert E. Raymond Oct. p 82

Porous Metal Filters
By Edward D. Kane May p 76

Proper Use of Relief Valves
By I. Leonard Kaplan Oct. p 87

Proportional Braking with a Fluid Motor
By John A. Lankester Sept. p 88

Safety and Control Ideas from a Modern Oil Powered Coal Handling System
By John R. Fawcett Apr. p 69

Series Connected Cylinders for Synchronized Control with an Overload Detector Device
By Robert E. Raymond
Apr. p 78

Speed and Torque Output from Hydraulic Transmissions
By Dennis W. Prosser Apr. p 75

The Fluid Power Engineering Index 1931-1955 Jan. p 65

200 HP Drive Reduces Hoist Cost
By R. J. Mitchell Oct. p 125

Use Oil Power to Replace Electric Crane Drive
By Kent C. Thornton June p 62

Valve Operating Time is Coordinated with Pump Reversal
By Ransom Tyler Nov. p 97

COMPONENT DESIGN

Brake "Feel" Problem Solved with Modified Pressure Controls
By Heinz Nowak Sept. p 93

Comparing 3 Servo Valve Designs
By W. G. Holzbock Nov. p 79

Self-Displacing Accumulator
By Scott Hawkins and E. R. Cooper Aug. p 80

Valve Design for High Pressure and Delivery
By John A. Lankester Oct. p 138

Do You Need an Explosion-Proof Circuit? Feb. p 47

Electric Motors
By Allan E. Morris Apr. p 59

Electro-Hydraulic Servo Valves May p 71

Hydraulic Motors
By R. C. Burnham Feb. p 48

Pilot Operated Circuit Starts Giant 1500 HP Mill
By J. A. Krapf Aug. p 70

Unidirectional Flow from a Pump Rotated in Both Directions
July p 93

Variable Pump Displacement by Pulse Generation
By Robert E. Raymond
Sept. p 67

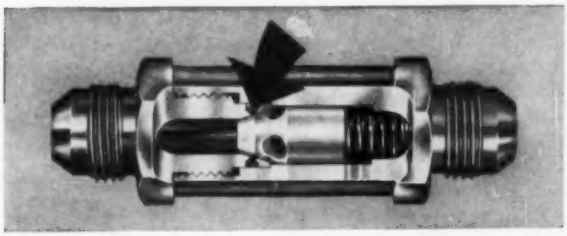
ELECTRICAL CONTROLS

Air Actuated Counters Control Winder
By Thomas Baxter June p 59

Circle 56 on Reader Service Card

Simple, Secure . . . Leak-Tight!

The FLEXIBLE SEAL SEAT*



Responsive action of the soft O-ring seal provides absolute leak-tightness. Instantly compresses to seal internal and external pressures. Draws harmlessly around dirt particles. No costly precision parts; no extra end seals. Stocked in 6 standard Dryseal pipe and JIC tube sizes; 12 connection combinations. Write for data sheet.

KEPNER PRODUCTS COMPANY
7221 West 59th Street • Summit, Illinois

Kep-O-seal

HYDRAULIC & PNEUMATIC
CHECK VALVES

* PATENT APPLIED FOR

Circle 44 on Reader Service Card

Announcing—

A NEW GRESEN VALVE
With FLOAT Position

GRESEN HYDRAULICS

A Two Spool Directional Control With Float

FEATURES: Detent in Float Position—Self Centering From Power Positions—Fully Balanced—Relief Valve Has Replaceable Hardened Seat—Tripod Mounting Feet—Smooth Positive Throttling Action—Hardened and Chrome Plated Spools.

SPECIFICATIONS: Capacity 20 GPM (at 20 Ft/seconds)—Maximum Pressure 1500 PSI—Parallel Application—Shipping Weight 22-1/2 Lbs.

Write for literature

GRESEN MANUFACTURING CO.
628 Colfax Ave. N. Dept. H-126 Minneapolis 11, Minn.

3000 psi won't get by the threads of Allen ⬡ Dryseals!

ALLEN 'TRU-ROUND' Dryseal Pipe Plugs

formed from special analysis ALLENOY steels.

Sold only through leading industrial distributors—specify genuine Allen Dryseal Pipe Plugs.

standard sizes from 1/16" to 1-1/4"

Here's the dependable, metal-to-metal seal you need for hydraulic systems . . . for transmission, control, and automated mechanisms where pressures run high. The N.P.T.F. threads of Allen O Dryseal Pipe Plugs are smooth, burnished, and burr-free — do their job without any help from sealing compounds. Allen's unique "pressur-forming" process assures the highest degree of precision threading and dimensional accuracy. What's more, Allen O Dryseals are precisely round at root, pitch and crest, with taper held to extremely close tolerances.

Allen engineers will gladly help you to harness your hydraulic pressures. Just write.

ALLEN HEAD

ALLEN
MANUFACTURING COMPANY
Hartford 2, Connecticut, U.S.A.

CENTURY
RESERVOIR ACCESSORIES

BREATHER CAP (Model 8585)

- Contains replaceable dust & moisture proof air filter element
- Available with or without flange assembly
- Easy to install

Century carries a complete line of:

- STANDARD POWER UNITS—(SPECIALS TO ORDER)
- STANDARD RESERVOIRS
- RESERVOIR ACCESSORIES—
  - Oil-Level Sight Gage
  - Oil Clarifier Unit
  - Filler Breather Assembly
  - Breather Cap

Engineers—Send for new catalog containing complete dimensional information on reservoirs, accessories, etc.

CENTURY HYDRAULICS, INC.
7703 LYNDON AVE. • DETROIT 38, MICHIGAN
Telephone: Diamond 1-3797

Circle 7 on Reader Service Card

Circle 24 on Reader Service Card

Electrical Components for Fluid Powered Equipment
By Allan E. Morris Feb. p 43

Electro-Hydraulic Circuits for 700 Ton Plastic Press
By R. C. Seanor June p 72

Electronic Timing Circuit Cuts Press Setup Time
By Robert Rosencranz June p 68

How Multiple Motions are Controlled on a Mechanized Dipping Operation
By Paul H. Winter Nov. p 85

How to Select and Use Limit Switches for Fluid Power Circuits
By Allan E. Morris May p 108

Pressure Switches for Fluid Power Control—Part 1
By Allan E. Morris Aug. p 56

Pressure Switches for Fluid Power Control—Part 2
By Kenneth B. Rexford Sept. p 79

Push Button Control—Part 1
By Allan E. Morris Nov. p 99

Solenoid Actuates Pump Control June p 64

Timers for Fluid Power Control
By Allan E. Morris July p 94

FEED CIRCUITS

All Pneumatic Timing Circuits
By William J. O'Connell Aug. p 54

Built-In Mechanically Actuated Pilot Valves Add Simplicity and Speed to Air Circuit Apr. p 63

Cam Sequenced Index Table with Fluid Motor Drive
By M. L. Hutchens and J. Finley Mar. p 75

Design of a Planer Loader
By John R. Fawcett July p 72

Ship Lays Cable . . . 153 Feet Per Minute Using Oil Driven Winches Oct. p 145

Small Volume Metering for Very Fine Cutting Feeds
By Karl Schubert July p 70

Speed Control Methods for a Broaching Machine Nov. p 77

Surge Control on Tool Feed Circuits
By James Tankard Mar. p 65

HYDRAULIC FLUIDS

Cold Weather Operation of Hydraulics Feb. p 67

Fluid Properties for Servomechanisms
By L. B. Taplin May p 116

Hydraulic Fluids for 400 F
By Harry M. Schiefer and Bernard Rubin July p 102

Why and When to Drain Hydraulic Oil
By R. Q. Sharpe Aug. p 47

MACHINE TOOLS

A Hydraulic Designer's Checklist
By John W. Reed June p 55

Air Cylinders Actuate Mechanisms to Automate Gear Hobbers Nov. p 73

Cam Sequenced Index Table with Fluid Motor Drive
By M. L. Hutchens and J. Finley Mar. p 75

Combination Pumps Power Grinding Machine
By P. O. Wernicke and J. C. Horth July p 77

Design of a Planer Loader
By John R. Fawcett July p 72

Design of Hi-Lo Circuits Apr. p 53

Designer's Sketchpad of Fluid Powered Mechanisms Mar. p 69

Four Simple Circuits Improve Machining Operations July p 89

How to Apply Closed Loop Hydraulics to Machine Tools
By Paul Maker and E. L. Dix Oct. p 76

Hydraulic Tracer Circuit for Contour Milling Machine
By W. C. Kraft July p 67

Hydraulics Replaces Mechanical Drive Sept. p 96

"No Jump" Circuit to Smooth Motion of Machine Table
By David Hutchinson Oct. p 128

Oil Powered Indexing Eliminates Layout Time July p 82

Pressure Control for Accurate Countersinking
By Alexander D. Roubloff July p 75

Safety, Flexibility and Accuracy with Semi-Automatic Honing Circuit
By R. C. Engle Nov. p 104

Shuttle Valves for Sequence Control
By H. Veith and W. M. Myers Mar. p 82

Small Volume Flow Metering for Very Fine Cutting Feeds
By Karl Schubert July p 70

Speed Control Methods for a Broaching Machine Nov. p 77

Surge Control on Tool Feed Circuits
By James Tankard Mar. p 65

MAINTENANCE METHODS

How to Salvage Press Piston Rods Apr. p 75

Prevent Rust in Hydraulic Systems Apr. p 73

MOBILE EQUIPMENT

Accumulator Cushions a Shifting Load Nov. p 92

Cold Weather Operation of Hydraulics Feb. p 67

Drive Development for a Fork Lift Truck
By Walter M. Shaffer Dec. p 75

Drive and Jack Circuit for Railway Maintenance Car
By William L. Royall June p 84

Dual Fluid Motors for Two Speed Control
By William M. Shook Dec. p 68

Fluid Motor in Drive Wheels Simplifies Tractor Design
By H. J. Hamblin Dec. p 60

Fluid Motor Rotates 3500 LB Load May p 114

Hydrostatic Transmissions for Mobile Equipment Dec. p 57

Modeling with Hydraulics
By W. H. Chaffee and C. Markle Dec. p 86

More Power in Smaller Package Puts a Hydrostatic Drive on a Lift Truck
By L. D. Huffman and R. W. Bruins Apr. p 57

New Broom Sweeps Clean Dec. p 84

No Clutch for this Engine Driven Pump Apr. p 66

"No Jump" Circuit to Smooth Motion of Machine Table
By David Hutchinson Oct. p 128

Oscillating Torque Motor Eliminates Complicated Linkages
By B. A. Pearson Aug. p 74

Pilot Check Times Accumulator Action on Spike Pulling Machine Aug. p 51

Railway Maintenance 100% Fluid Power
By E. J. Powell Dec. p 72

Servo Speed Control for a Hydrostatic Drive
By E. M. Arentzen and D. J. Arnold Dec. p 64

Simple Lever System Plus Hydraulics Make a Powerful Hoist June p 66

Telescoping Cylinder Lifts Truck Cab for Maintenance
By Merrill C. Horine June p 81

Where's the Place for Fluid Power on an Automobile?
By John A. Lankester Aug. p 60

PACKINGS

Delta Backup Ring for Dynamic Sealing Oct. p 142

Increased O-Ring Life
By Gilbert C. Close Feb. p 61

Packings for Air and Oil Cylinders
By E. P. Stahl Mar. p 91

Spring Loading Increases Cup Packing Life Oct. p 134

PRESS INSTALLATIONS

A Hydraulic Designer's Checklist
By John W. Reed June p 55

Air Hydraulic Device Protects Press Tools Mar. p 126

Air Powers Press Transfers for Speed and Reliability May p 104

Combination Pump to Reduce Horsepower
By Frank Arpagian Sept. p 84

Design of Hi-Lo Circuits Apr. p 53

Electro-Hydraulic Circuits for 700 Ton Plastic Press
By R. C. Seanor June p 72

Pneumatic Timing Circuit Devised for Punch Press Safety
By Clifford J. Lane Mar. p 80

Power and Control for Compression Plastic Molding
By Henry Green Feb. p 63

Press Differential Circuit Uses Smaller Size Valving
By Rex Burnham Nov. p 95

Circuit Revised for More Speed
By Harvey Barnes Feb. p 64

SERVO SYSTEMS

Comparing 3 Servo Valve Designs
By W. G. Holzbock Nov. p 79

Electro-Hydraulic Servo Systems
By J. Wesley Broome May p 66

Electro Hydraulic Servo Valves
May p 71

Electronic Position Servo Controls Hydraulically Driven Web Cutter
By Joseph Reed Nov. p 67

Fluid Properties for Servomechanisms
By L. B. Taplin May p 116

Hydraulic Powered Flying Controls —Part 1, Part 2
By John A. Lankester Feb. p 71
Mar. p 111

How to Apply Closed Loop Hydraulics to Machine Tools
By Paul Maker and E. L. Dix
Oct. p 76

Jet Engine Control . . . Servo Pump or Servo Valve
By L. D. Taylor May p 119

Mechanical Control of Servo Valves to Regulate Prime Mover Speed
By H. W. Hamm May p 93

Pneumatic and Hydraulic Controls for Fluid Motor Drives
By Milton G. Malmquist
May p 80

Pump Control for Ship Steering Gear
By R. C. Lamond and V. A. Olson
May p 101

Resistance Type Servo Circuits
By J. R. Fawcett May p 87

Servo Speed Control for a Hydrostatic Drive
By E. M. Arentzen and D. J. Arnold Dec. p 64

Servo System Reduces Ship Roll
May p 78

Synthesis of Aircraft Hydraulic Servos
By George R. Keller and Elliott R. Buxton Dec. p 90

SPECIAL PLANT EQUIPMENT

Air Actuated Counters Control Winder
By Thomas Baxter June p 59

All Pneumatic Timing Circuits
By William J. O'Connell Aug. p 54

Automatic Soldering Circuit Reduces Handling and Costs
By George Kartman Mar. p 95

Converted Mechanical Barrel Former Uses a Two Pressure Pump Control
By A. H. Snipes Mar. p 128

Electro-Pneumatic Circuits for a Welder
By C. R. Chew Oct. p 130

Fast Economical Shell Molding . . . How it is Done with Air
By H. H. Sonderegger June p 70

For a Better Job Use an Air Powered Lever
By Daniel A. Keefe Aug. p 66

Hairpin Stripper Uses Six Air Circuits
Sept. p 75

Here's What an Automation Department Does Sept. p 82

How an Automatic Transfer Problem is Solved with Electro-Pneumatics
By J. B. Patterson Nov. p 89

How Multiple Motions are Controlled on a Mechanized Dipping Operation
By Paul H. Winter Nov. p 85

How to Arrange Hand Valve Controls from 2 or 3 Stations
By Wayne M. Sanderson
Sept. p 86

Hydraulic, Pneumatic Electrical Circuits Combined in this Piercing Tool
By John Foy Nov. p 109

Limit Switches Sequence Hydraulic Circuit
By H. T. Munton June p 77

Multiple Vise Setup for Simpler Tooling
By John E. Hyler Mar. p 136

Pilot Operated Circuit Starts Giant 1500 HP Mill
By J. A. Krapf Aug. p 70

Pneumatics Assists Transformer Builder
By George Kartman Sept. p 104

Press-Fit Tooling Throws Out Bad Parts
Mar. p 88

Solenoid Actuates Pump Control
June p 64

STANDARDS

How to Read JIC Circuits
By Peter Coffaro July p 86

SYSTEM PLUMBING

How to Use Self Sealing Couplings
By Robert J. Dawson Apr. p 92

Swivel Joints . . . What They Are . . . How They're Used
By J. O. Heyworth Sept. p 71

TEST EQUIPMENT

Equipment for Pump and Motor Performance
By Robert Schwary Feb. p 52

Fluid Motors Combine with Analog Computer to Test Jet Controls
By Robert G. Butterwick
Nov. p 119

How to Generate and Release 100,000 psi
By Robert W. Ellison Feb. p 54

Quick-Connect Leakproof Tube Fixture
By C. B. Weidner Mar. p 86

AUTHOR INDEX

Arentzen, E. M. and D. J. Arnold
Servo Speed Control for a Hydrostatic Drive Dec. p 64

Arnold, D. J. and E. M. Arentzen
Servo Speed Control for a Hydrostatic Drive Dec. p 64

Arpagian, Frank
Combination Pump to Reduce Horsepower Sept. p 84

Barnes, Harvey
Circuit Revised for More Speed
Feb. p 64

Baxter, Thomas
Air Actuated Counters Control Winder June p 59

Broome, J. Wesley
Electro-Hydraulic Servo Systems
May p 66

Bruins, R. W. and L. D. Huffman
More Power in Smaller Package Puts a Hydrostatic Drive on a Lift Truck Apr. p 57

Burnham, R. C.
Hydraulic Motors Feb. p 48

Burnham, Rex
Press Differential Circuit Uses Smaller Valving Nov. p 95

Butterwick, Robert G.
Fluid Motors Combine with Analog Computer to Test Jet Controls
Nov. p 119

Buxton, Elliott R. and George R. Keller
Synthesis of Aircraft Hydraulic Servos Dec. p 90

Chaffee, W. H. and C. Markle
Modeling with Hydraulics
Dec. p 88

Chew, C. R.
Electro-Pneumatic Circuits for a Welder Oct. p 130

Close, Gilbert C.
Increased O-Ring Life Feb. p 61

Coffaro, Peter
How to Read JIC Circuits
July p 86

Collins, Don F.
What's Titanium's Future in Aircraft Hydraulic Circuits May p 124

Cooper, E. R. and Scott Hawkins
Self-Displacing Accumulator Shortens Lines and Minimizes Pressure Losses Aug. p 80

Dawson, Robert J.
How to Use Self Sealing Couplings
Apr. p 92

Dix, E. L. and Paul Maker
How to Apply Closed Loop

Hydraulics to Machine Tools Oct. p 76

Ellison, Robert W.
How to Generate and Release 100,000 psi Feb. p 54

Engle, R. C.
Safety, Flexibility and Accuracy with Semi-Automatic Honing Circuit Nov. p 104

Fawcett, John R.
Safety and Control Ideas from a Modern Oil Powered Coal Handling System Apr. p 69

Resistance Type Servo Circuits May p 87

Design of a Planer Loader July p 72

Finley, J. and M. L. Hutchens
Cam Sequenced Index Table with Fluid Motor Drive Mar. p 75

Foy, John
Hydraulic Pneumatic Electrical Circuits Combined in this Piercing Tool Nov. p 109

Friedl, E. W.
Intensifier and Accumulator Circuit Mar. p 78

Garrett, Seymour S.
5 Ways to Use Accumulators Sept. p 76

Green, Henry
Power and Control for Compression Plastic Molding Feb. p 63

Hadekel, R.
Integrated Control Systems for Aircraft Dec. p 95

Hamblin, H. J.
Fluid Motor in Drive Wheels Simplifies Tractor Design Dec. p

Hamm, H. W.
Mechanical Control of Servo Valves to Regulate Prime Mover Speed May p 93

Hawkins, Scott and E. R. Cooper
Self-Displacing Accumulator Shortens Lines and Minimizes Pressure Losses Aug. p 80

Heyworth, J. O.
Swivel Joints . . . What They Are . . . How They're Used Sept. p 71

Holzbock, W. G.
Comparing 3 Servo Valve Designs Nov. p 79

Horine, Merrill C.
Telescoping Cylinder Lifts Truck Cab for Maintenance June p 81

Horth, J. C. and P. O. Wernicke
Combination Pumps Power Grinding Machine July p 77

Huffman, L. D. and R. W. Bruins
More Power in Smaller Package Puts a Hydrostatic Drive on a lift Truck Apr. p 57

Hutchens, M. L. and J. Finley
Cam Sequenced Index Table with Fluid Motor Drive Mar. p 75

Hutchinson, David
"No Jump" Circuit to Smooth Motion of Machine Table Oct. p 128

Hyler, John E.
Multiple Vise Setup for Simpler Tooling Mar. p 136

Kane, Edward D.
Porous Metal Filters May p 76

Kaplan, I. Leonard
Proper Use of Relief Valves Oct. p 87

Kartman, George
Automatic Soldering Circuit Reduces Handling and Costs Mar. p 95

Pneumatics Assists Transformer Builder Sept. p 104

Keefe, Daniel A.
For a Better Job Use an Air Powered Lever Aug. p 66

Keller, George R. and Elliott R. Buxton
Synthesis of Aircraft Hydraulic Servos Dec. p 90

Kraft, W. C.
Hydraulic Tracer Circuit for Contour Milling Machine July p 67

Krapf, J. A.
Pilot Operated Circuit Starts Giant 1500 HP Mill Aug. p 70

Lamond, R. C. and V. A. Olson
Pump Control for Ship Steering Gear May p 101

Lane, Clifford J.
Pneumatic Timing Circuit Devised for Punch Press Safety Mar. p 80

Lankester, John A.
Hydraulic Powered Flying Controls —Part 1 Feb. p 71

Hydraulic Powered Flying Controls —Part 2 Mar. p 111

Proportional Braking with a Fluid Motor Sept. p 88

Valve Design for High Pressure and Delivery Oct. p 138

Where's the Place for Fluid Power on an Automobile? Aug. p 60

Maker, Paul and E. L. Dix
How to Apply Closed Loop Hydraulics to Machine Tools Oct. p 76

Malmquist, Milton G.
Pneumatic and Hydraulic Controls for Fluid Motor Drives May p 80

Markle, C. and W. H. Chaffee
Modeling with Hydraulics Dec. p 88

Middleton, Ralph E.
Hydraulic and Pneumatic Problems in High Performance Aircraft Dec. p 98

Mitchell, R. J.
200 HP Drive Reduces Hoist Cost Oct. p 125

Morris, Allan E.
Electrical Components for Fluid Powered Equipment Feb. p 43

Electric Motors Arp. p 59

How to Select and Use Limit Switches for Fluid Power Circuits May p 108

Timers for Fluid Power Control July p 94

Pressure Switches for Fluid Power Control—Part 1 Aug. p 56

Push Button Control—Part 1 Nov. p 99

Munton, H. T.
Limit Switches Sequence Hydraulic Circuit June p 77

Myers, W. M. and H. Veith
Shuttle Valves for Sequence Control Mar. p 82

Nowak, Heinz
Brake "Feel" Problem Solved with Modified Pressure Controls Sept. p 93

O'Connell, William J.
All Pneumatic Timing Circuits Aug. p 54

Olson, V. A. and R. C. Lamond
Pump Control for Ship Steering Gear May p 101

Patterson, J. B.
How an Automatic Transfer Problem is Solved With Electro-Pneumatics Nov. p 89

Pearson, B. A.
Oscillating Torque Motor Eliminates Complicated Linkages Aug. p 74

Person, P.
Load Limiting Devices for Retractable Aircraft Cylinders Sept. p 106

Powell, E. J.
Railway Maintenance 100% Fluid Power Dec. p 72

Prosser, Dennis W.
Speed and Torque Output from Hydraulic Transmissions Apr. p 75

Raymond, Robert E.
Series Connected Cylinders for Synchronized Control with an Overload Detector Device Apr. p 78

New Ideas for Pressure Control on Oil Hydraulic Equipment Oct. p 82

Variable Pump Displacement by Pulse Generation Sept. p 67

Reed, John W.
A Hydraulic Designer's Checklist June p 55

Reed, Joseph
Electronic Position Servo Controls Hydraulically Driven Web Cutter Nov. p 67

Rexford, Kenneth B.
Pressure Switches for Fluid Power Control—Part 2 Sept. p 79

Richner, William M.
How to get Accurate Flow Readings When Testing Aircraft Components Nov. p 111

Rosencranz, Robert
Electronic Timing Circuit Cuts Press Setup Time June p 68

Roubloff, Alexander D.
Pressure Control for Accurate Countersinking July p 75

Royall, William L.
Drive and Jack Circuit for Railway Maintenance Car June p 84

Rubin, Bernard and Harry M. Schiefer
Hydraulic Fluids for 400 F July p 102

Sanderson, Wayne M.
How to Arrange Hand Valve Controls from 2 or 3 Stations Sept. p 86

Schiefer, Harry M. and Bernard Rubin
Hydraulic Fluids for 400 F July p 102

Schubert, Karl
Small Volume Flow Metering for Very Fine Cutting Feeds July p 70

Schwary, Robert
Equipment for Pump and Motor Performance Feb. p 52

Shaffer, Walter M.
Drive Development for a Fork Lift Truck Dec. p 75

Seanor, R. C.
Electro-Hydraulic Circuits for 700 Ton Plastic Press June p 72

Sharpe, R. Q.
Why and When to Drain Hydraulic Oil Aug. p 47

Shook, William M.
Dual Fluid Motors for Two Speed Control Dec. p 68

Snipes, A. H.
Converted Mechanical Barrel Former Uses a Two Pressure Pump Control Mar. p 128

Sonderegger, H. H.
Fast Economical Shell Molding . . . How it is Done with Air June p 70

Stahl, E. P.
Packings for Air and Oil Cylinders Mar. p 91

Tankard, James
Surge Control on Tool Feed Circuits Mar. p 65

Taplin, L. B.
Fluid Properties for Servo-mechanisms May p 116

Taylor, L. D.
Jet Engine Control . . . Servo Pump or Servo Valve May p 119

Thornton, Kent C.
Use Oil Power to Replace Electric Crane Drive June p 62

Tyler, Ransom
Valve Operating Time is Coordinated with Pump Reversal Nov. p 97

Veith, H. and W. M. Myers
Shuttle Valves for Sequence Control Mar. p 82

Weidner, C. B.
Quick-Connect Leakproof Tube Fixture Mar. p 86

Wernicke, P. O. and J. C. Horth
Combination Pumps Power Grinding Machine July p 77

Winter, Paul H.
How Multiple Motions are Controlled on a Mechanized Dipping Operation Nov. p 85

6000 PSI

wide range, high-flow regulator

maintains high degree of accuracy with regulated pressures from 0 to 5000 psi!

performance features:

- Normal inlet pressure of 6000 psi!
- Wide adjustment range of 0 to 5000 psi with extreme sensitivity!
- Burst — 15,000 psi!
- Maximum required handle torque 30 inch lbs. due to planetary gear system in handle!
- Adaptable for use with air, nitrogen, helium and gaseous oxygen!
- ¼" tube straight thread gasket seal bosses per AND10050!
- Also available in AND10053 ¼" pipe thread!
- Internal valve and filter are removable without disturbing spring, diaphragm structure!
- Internal relief valve adjustable over entire outlet pressure range!
- Internal 5 micron filter!
- Bubble-tight shut-off!
- Adjustable mounting!

Please send me engineering data information on:

Part 110700—Air, nitrogen, helium. _____

Part 111700—Gaseous oxygen only. _____

APCO

ACCESSORY PRODUCTS CORP.

Dept. A-12 616 W. Whittier Blvd.

Whittier, Calif. Phone: OXford 3-3747

TECHNICAL EDITOR WANTED

Opportunity to join APPLIED HYDRAULICS staff. If you have design experience, an EE or ME degree, can write fluently and well and want a stimulating job, send your resume to:

Editor
APPLIED HYDRAULICS
812 Huron Road
Cleveland 15, Ohio

MARKET PLACE

SHOP SUPERVISOR—WANTED

At least five years experience in the manufacture and assembly of high pressure piston type oil pumps. Must be capable of supervising both assembly and test of this equipment. Excellent opportunity. Permanent. Salary open. Reputable manufacturer. Location Eastern Seabord. Replies confidential. Write APPLIED HYDRAULICS, Box 21256.

AIR POWER—IDEA POWER

Pneumatic Power was never so efficient, so versatile, never answered so many machine design problems —and exciting new developments so to be announced by Ross will advance it even further. This new era for pneumatics is largely due to the Ross determination to bring industry tomorrow's AIRmation today. The better Ross valves that have resulted have continued to be so well received by industry, that new engineers like those who have put Ross out front are needed.
If you have the courage to advance a fresh idea, and the resourcefulness and engineering experience to make it reality, then we invite you to consider joining the Ross Engineering staff. For home office work contact Ross Operating Valve Company, 120 East Golden Gate, Detroit 3, Michigan; for field work contact your nearby Ross representative.

WANTED: HYDRAULIC SALES ENGINEER

FOR HYDRAULIC SALES IN EAST COAST TERRITORY. PREFER GRADUATE MECHANICAL ENGINEER OR EQUIVALENT WITH PRACTICAL HYDRAULIC OR SIMILAR EXPERIENCE. SOME SALES EXPERIENCE PREFERRED. SALARY AND BONUS. SEND DETAILED RESUME TO JOHN JORGENSEN, OIL HYDRAULICS DIVISION, WERSTER ELECTRIC COMPANY, RACINE, WISCONSIN.

DISTRIBUTORS WANTED

Profitable, complete line of hose, hose assemblies, hose and tube fittings. Low, medium and high pressure applications on replacement and original equipment in every industry. An excellent, proven line, national advertising, merchandising support, product training for your salesmen. You will be backed by over 25 years of pioneering in this fast growing field. For an interview with one of our representatives, write FLEX-O-TUBE, Meridan Corp., 2527 Jim Daly Road, Inkster, Mich.

Classified Advertising Rates: Cost of position Wanted Ad is $10.00 for the first inch, each additional line 90 cents. Cost of all other classified ads is $20.00 for the first inch and $15.00 for each additional inch or fraction thereof. Rates for Display Ads in this section will be sent on request.

Air & Hydraulic Cylinders

• FOR HEAVY-DUTY APPLICATIONS OF ALL TYPES • TO MEET ALL SIZE AND PRESSURE REQUIREMENTS • BORES TO 32″ DIAMETER • STROKES OF 50 FT. AND LONGER.

Lincoln Machine Company will design, engineer and build standard or special hydraulic and pneumatic cylinders with trunion, rod-end flange, blank-end flange, foot, clevis or centerline mountings.

Call on Lincoln when you require large, powerful rotating or non-rotating hydraulic and air cylinders, heavy-duty mill-type cylinders. Our engineering department will give you fast, practical assistance in design problems . . . and our modern plant will build your cylinders quickly and economically.

Write today for Lincoln's catalog. It gives engineering data on many types and sizes of heavy-duty cylinders.

LINCOLN MACHINE CO. INC.
P O BOX 272 • SALEM, OHIO

ADVERTISERS' INDEX

December 1956

Accessory Products Corp. 139
Ace Products Co. 100
R. P. Adams Co., Inc. 111
Adel Precision Products Div.
General Metals Corp. 38
Air-Mite Industrial Air Equipment,
Inc. 127
The Airoyal Company 115
The Allen Mfg. Co. 135
Almo Tool Company 123
The Alpha Molykote Corp. 119
American Hollow Boring Co. 130
Anchor Coupling Co., Inc. 5
George Angus & Co., Ltd. 41
Arrow Tools, Inc. 78
Atkomatic Valve Co., Inc. 123
Automatic Valve Co. 129

Barksdale Valves 80
Bellows Co. 79
Bendix Aviation Corporation
Pacific Division 104
Benton Harbor Engineering Works,
Inc. 121
Birmingham Hydraulics 127
Briggs Filtration Co. 120
Brown & Sharpe Mfg. Co. 37

Capital Engineering & Mfg. Corp. 114
Carbide & Carbon Chemicals Co.
Division of Union Carbide & Carbon
Corp. 14
Cardwell Machine Co. 110
Century Hydraulics, Inc. 135
Char-Lynn Co. 108
Chicago Rawhide Mfg. Co. 19
Commercial Shearing & Stamping
Co. 77
Crane Packing Company 4
Cross Manufacturing Co. 116

Darling Valve & Mfg. Co. 131
Denison Engineering Division
American Brake Shoe Co. 16, 17
Dollinger Corp. 27
Dowty Hydraulic Units Ltd. 89

Eastman Mfg. Co. 11

Fawcett-Finney Ltd. 129
Flex-O-Tube Div.
Meriden Corp. 44
Fluid Controls, Inc. 130
Foster Manufacturing Co., Inc. 111
S. G. Frantz Co., Inc. 20
Fuller Company 54
Futurecraft Corp. 116

Galland-Henning
Nopak Division 133
Gast Mfg. Corp. 123
Greer Hydraulics, Inc. 126
Gresen Manufacturing Co. 135
J. D. Gould Co. 115

Hanna Engineering Works 1
Hannifin Corp. 47
Hansen Mfg. Co. ..... Cover 2
Hoke, Inc. 100
E. F. Houghton & Co. 9
Hydraulic Accessories Co. 127
Hydro-Line Mfg. Co. 10
Hydromotor Division
Ex-Cell-O Corp. 97

Johns-Manville 32

Keelavite Rotary Pumps & Motors,
Ltd. 83
Kepner Products 135
Koppers Company, Inc.
Metal Products Div. 25
Kraissl Co., Inc. 122

L & L Manufacturing Co. 81
Lenz Co. 118
Lincoln Machine Co., Inc. 140
Linear, Inc. 109
Lynair, Inc. 129

R/M FABRIC PISTON CUPS MEET ALL 5 OF YOUR REQUIREMENTS

The general outward appearance of R/M Fabric Piston Cups—clear definition of contours, smooth surfaces, clean trimming—is evidence of plenty of top-flight precision molding practice. Accurate, carefully controlled, this assures dimensional uniformity and therefore maximum sealing effectiveness.

Cut an R/M Fabric Piston Cup apart and you will see the purpose for R/M's special impregnation method — deeper, more thorough penetration of the compound into the fabric. This keeps wicking action from destroying the cup internally. It also builds up greater resistance to ply delamination.

R/M Fabric Piston Cups are thoroughly inspected, hardness is consistent, and they adhere strictly to industry standard sizes. To meet your requirements, R/M engineers will recommend the proper combination of asbestos or other strength member with rubber-like synthetic composition to best meet temperature and pressure conditions.

R/M MAKES A COMPLETE LINE OF MECHANICAL PACKINGS

R/M's line of molded hydraulic and pneumatic packings includes:

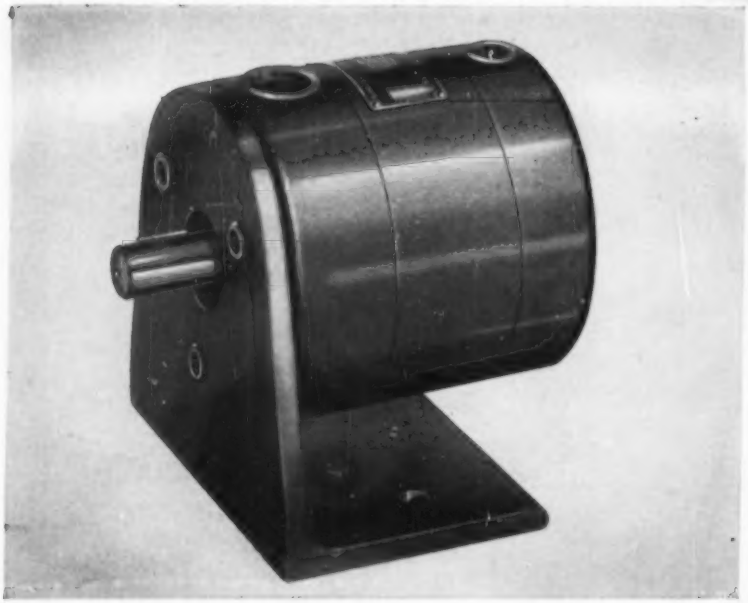
VEE-FLEX PACKINGS
VEE-SQUARE PACKINGS
HOMOGENEOUS VEE-RINGS
FABRIC PISTON CUPS

For complete information, send for booklet

RM **PACKINGS**
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.; Neenah, Wis.; Crawfordsville, Ind.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Packings • Asbestos Textiles • Industrial Rubber, Engineered Plastic, and Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Laundry Pads and Covers • Bowling Balls



a new LOW-PRICED radial piston pump

Here is a hydraulic pump that provides the high performance characteristic of piston-type pumps—at a price usually associated only with pumps of vane or gear design.

This is made possible by utter simplicity in design, coupled with a revolutionary "shrink seal" feature, and the economical SECO radial design.

The Model D-5 illustrated is rated at 2000 PSI maximum—5 GPM—at 1800 R.P.M. using 235 SSU oil at 100° F. *The over-all efficiency is above 90% for a wide range of operating conditions.*

A simplified feed-back control with external valving can be utilized to accomplish variable displacement—with resulting advantages, such as constant pressure feed-back control, economy in horsepower, etc.

If you use vane or gear type pumps within the range of this new pump, please use the Reader's Service Card for more complete information and prices—

SECO **SERIES "D" PUMP**

SIMPLEX ENGINEERING CO.
ZANESVILLE, OHIO

ADVERTISERS' INDEX

M. C. Manufacturing Co. 94
C. W. Marsh Corp. 101
Marvel Engineering Co. 43
Mayson Manufacturing Co. 133
Mechanical Air Controls, Inc. 112, 113
Metal Industries, Ltd. 129
Miller Fluid Power Div.
Flick K-Reedy Corp. 13
Minnesota Rubber & Gasket
Company 2
Modernair Corp. 133
Monsanto Chemical Co. 106

National Seal Div.
Federal-Mogul-Bower Bearings,
Inc. 125
New York Air Brake Co.
Kalamazoo Division 53
Wm. W. Nugent & Co., Inc. 12
Numatics, Inc. 36

Ortman-Miller Machine Co. 35

Parker Appliance Co.,
Rubber Products Div. 99
Pathon Mfg. Co. 105
Periflex, Inc. ..... Cover 3
Pesco Products Div.
Borg-Warner Corp. 23
Pneu-Trol Devices, Inc. 127
Power Jacks, Ltd. 50
Precision Rubber Products Corp. 7

Quincy Compressor Company 132

Raybestos-Manhattan, Inc.
Packing Division 141
Republic Manufacturing Co. 119
Republic Steel Corp. 39
Resistoflex Corp. 46
Rivett Incorporated 8

A. Schrader's Son Div.
of Scovill Mfg. Company 40
Schroeder Bros. Corp. 124
Shenango Furnace Co.
Centrifugally Cast Products Div. 28
Simplex Engineering Co. 142
Snap-Tite, Inc. 49
Socony Mobil Oil Co., Inc. 93
Standard Oil Co. (Indiana) 85
Standard Pressed Steel Co. 119
Star Jack Co., Inc. 133
Stratos Division
Fairchild Engine & Airplane Corp. 22
Sun Oil Co. 33, 34
Superior Tube Co. 31

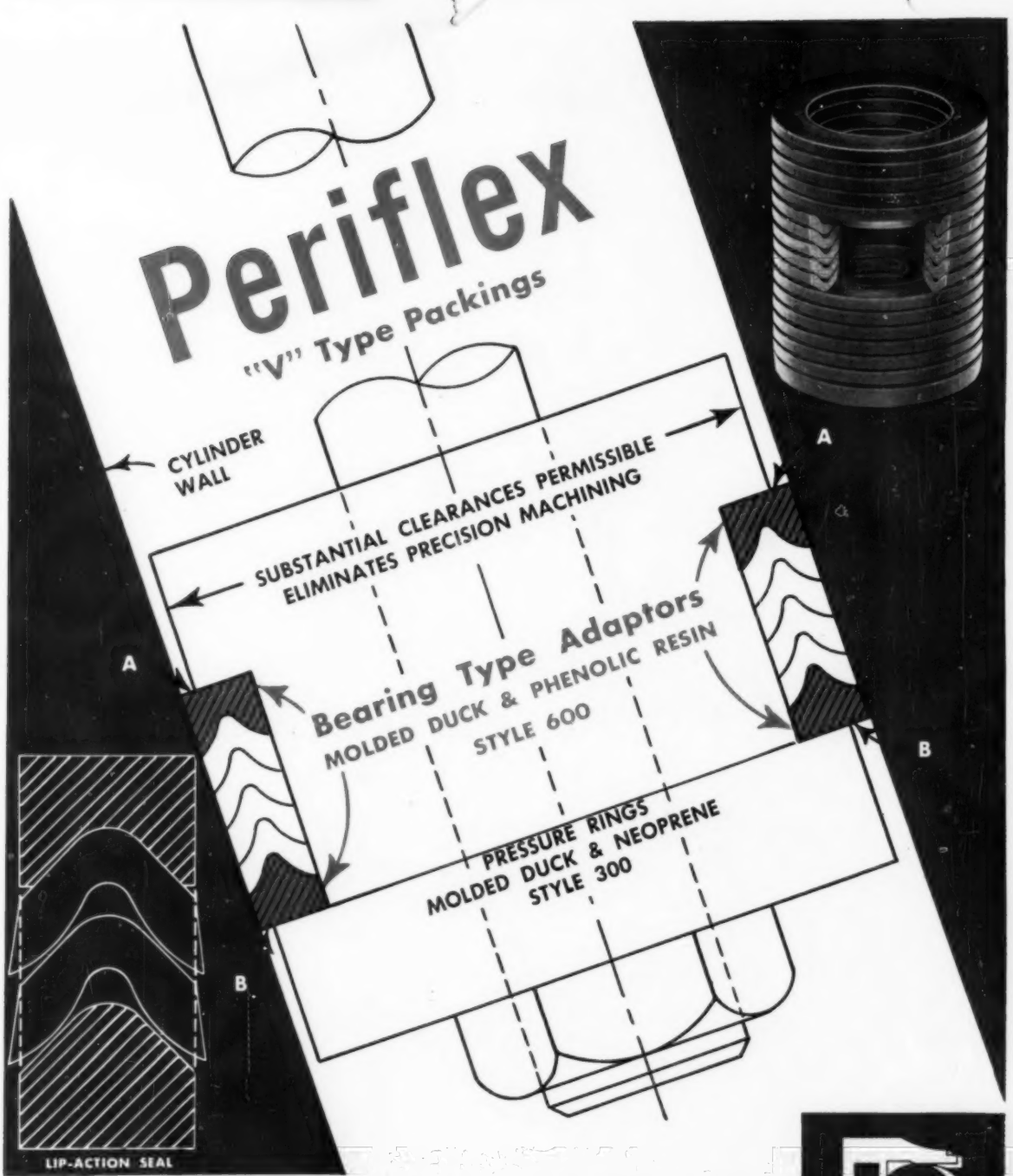
The Texas Co. 56
Titeflex, Inc. 21
Tomkins-Johnson Co. 15
Tru-Seal Div.
Flick-Reedy Corporation 116
Tube Reducing Corporation 103

U. S. Gasket-Belmont Packing 117
U. S. Gauge Div.
American Machine & Metals, Inc. 30
U. S. Rubber Co.
Naugatuck Chemical Div. 29
United Metallic "O" Ring Corp.
Div. of United Aircraft Products,
Inc. 120

Vickers, Inc.
Division of Sperry Rand Corp. 87
Victor Equipment 100
Henry Vogt Machine Co. 51

Waterman Engineering Co. 55
Weatherhead Company 91
Webster Electric Co. 45
Weldon Tool Co. 26
West Cost Electrical Mfg. Corp. 124

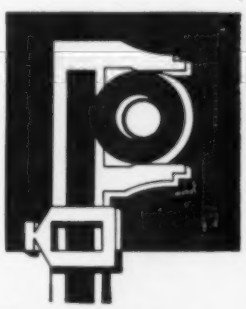
Young Radiator Co. 115



How Periflex Molded "Phenol-Fab" Bearing Type Adaptors Make Famous Periflex V-Ring Sets Work Even Harder For You

1. Phenolic Resin and Duck adaptors eliminate extrusion at locations "A" and "B"—works under any pressure.
2. Phenolic Resin, like bronze, gives you piston bearing at locations "A" and "B".
3. Reduces machining costs. No critical dimensions to hold.
4. Ease of assembly, even for inexperienced field men.

Write for Complete Information



Periflex • Inc.

HAZEL PARK
MICHIGAN

Circle 80 on Reader Service Card

Coming in January Designers' Guide Issue . . .

APPLIED HYDRAULICS

- **Answers to thousands of questions for FLUID POWER DESIGNERS**

Every day mail addressed to our editors brings requests from readers asking who makes a valve, cylinder, pump, motor, accumulator, etc. in given size, given pressure range, given flow rate, given size or types of port threads. Literally thousands of questions asking "Who makes it—where can I get it?"

To help answer these and to make it simple for many other thousands of designers to get their answers quickly and easily, APPLIED HYDRAULICS will publish in January fifty pages of charts providing quick guides to product selection.

25 QUICK GUIDES TO PRODUCT SELECTION

Quick guide selection charts for the following twenty-five products will be one of the major features of the January, 1957 issue of APPLIED HYDRAULICS. These guides will cover all major components used in the fluid power field.

CHARACTERISTICS DESIGNERS NEED TO KNOW

The chart for each of the twenty-five products will list what companies make the product and will indicate the important specification characteristics.

REVISED FLUID POWER CIRCUITS ALSO IN JANUARY

The Fluid Power Circuits published three years ago, and for which over 15,000 reprint orders were received, have been revised and will also be published in the January, 1957 issue. This section will illustrate 100 different circuits covering 32 pages. A description of the operation of each circuit will be given. Here is another valuable working tool for all fluid power designers.

FOR ADVERTISING RESULTS

Here will be an issue that no fluid power advertiser will want to miss. Here in a single issue are the elements of valuable reference for designers and engineers throughout the more than 30 major industries that are large users of hydraulics, pneumatics and electrical controls.

The charts and the circuit diagrams will help the reader select the companies making the products with the characteristics in the range of those required for the particular application. The circuit diagrams will assist in arranging the components within the different circuit requirements. But only your advertising can pinpoint the exact and desirable specifications of your product. Here will be an issue of long reference value that will have year 'round use by designers searching for sources of products. And, an advertisers' product index will assist readers to find your company's ad.

BE SURE TO PUT THIS JANUARY ISSUE
ON YOUR 1957 SCHEDULE NOW!

Advertising Deadline—December 15, 1956

FRANCHISE CIRCULATION

APPLIED HYDRAULICS

812 HURON ROAD • CLEVELAND 15, OHIO